



INDIAN AGRICULTURAL
RESEARCH INSTITUTE, NEW DELHI.

FLA.R.L.C.

MGRC-84-10-24-245-1,000

THE SCOTTISH Journal of Agriculture.

VOLUME IV.

1921.

EDINBURGH:
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.

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EDINBURGH .
PRINTED BY DANIEL MACFARLANE AND CO., LTD.

The Scottish Journal of Agriculture.

VOL. IV.—No. I.]

JANUARY 1921.

PRICE 1s. NET.

CLAY-FARMING IN ABERDEENSHIRE.

JAMES CRUICKSHANK.

MY recollections of clay-farming in Aberdeenshire date from 1872. What fixes it in my memory is the fact that a steam plough came to the district in the spring of that year. It was worked by two large Fowler engines of 12 tons each with winding drums. The ploughing was very deep and done very fast, the grubbing and harrowing the same, and a lot of red clay was turned up. The end rigs were poached to a frightful extent, and it took about all the horses on the farm to keep the engines supplied with water and coals. It turned out a very wet summer, not unlike 1916, but considerably worse. It proved disastrous for clay land, and saw the last of the steam ploughing tackle in this particular district. Practically all the crops were a failure, and as it turned out it was the beginning of the end of many clay farmers. There was a succession of bad seasons and low prices, and during the following forty years about 95 per cent. of the farms in two fairly large adjoining parishes changed hands. It might be argued that this was a natural result of time, but not only did the farms change tenants, many of them three or four times, but out of nearly 300 holdings, large and small, less than twenty are now in the hands of even the same families. This clearly shows that it was anything but a profitable business.

I. CULTIVATION AND CROPPING.

In 1902, really as a matter of convenience for my business, I rented about 100 acres of land mostly heavy clay, and from 1908 to 1913 other 300 acres similar land adjoining becoming practically derelict, I readily got this at small rents.

I was further induced to rent this from my experience of the first 100 acres referred to, and a desire to overcome if possible some of the difficulties of working clay land, and to see if I could not recover something of what had been lost in the seventies.

I had long been of the opinion that had farmers on heavy land let their farms down to really good grass when things began to go wrong, in the late seventies and early eighties, many of those who went under might have weathered the storm. I was strengthened in this belief by observing the fact that farms that had gone down to grass—even poor grass—changed tenants less often than did those which continued in rotation, while rents did

not fall so much, in many cases not at all. In arranging for these farms, although bound to leave them in rotation if the proprietor specially asked me to do so, I did not bind myself to work them in rotation and arranged that I was to be paid for all sown grasses if I left them all in grass, with an allowance for the manurial value of the sod for all grass over four years old. In return I was to make no claim for unexhausted manures. If I made a claim I was to be paid for first year's grass only.

The greater part of the land had been drained in 1856 with drains 27 to 36 feet apart, 4 feet deep, 1½-inch pipes and collars, and although these drains are much too deep, it is wonderful how many of them were found to be running when the outlets were properly cleared.

I found nearly all the land laid out in 36-foot rigs to suit reapers and binders. Previous to the advent of these it had been in 12-foot rigs, and at an earlier period it had been in 9-foot rigs, and very highly ridged up. When laying out after cleaning I have put it all back into 12 to 14 feet rigs. Having the land well ridged up has a wonderful effect on the crops.

I am much indebted to members of the staff of the North of Scotland College of Agriculture, who were ever ready to assist with analyses and experiments, and I early learned that bones were not much good as a source of phosphates on the clay, and that potash was not necessary. Phosphates in the form of basic slag and superphosphate were the most necessary and best acting manures, along with lime, and these I have used regularly and liberally, using 2 tons per acre of lime carbonate (dried waste from paper-works) on all land broken up, putting it on the lea before ploughing,—when cultivating for turnips, or when bare fallowing,—whichever was most convenient—and the result has always been the same—better drainage, better tilth and better grass.

I had some experiments carried out for me on oats in 1905. It happened to be a good season for clay, and I had 14 acres oats with a few peas mixed that yielded 7 qrs. oats and 4 bushels peas per acre. In 1906 I tried a yaval crop of oats with a few peas mixed on this field. It proved rather a bad season for clay, and the crop was mostly thistles with a few peas. The oats had "seggit" or developed tulip-root almost to a plant. This was my first bad failure. The following year I had turnips in this field. I got them beautifully put in and hoed early. They got a check with wet weather, and almost to a bulb they shot (bolted), and were of little value. I have since learned that it is safer not to take a yaval crop of oats on clay land unless in good condition, or after three or four years' grass. If you must take a second crop, sow common bere or if you can dung the land in autumn, sow spring beans. There is nothing so likely to induce a bad turnip crop as a poor and weedy grain crop preceding, and particularly the land should not be worked when wet. Your horses are far better standing idle than working clay land when wet.

I had formed the idea, rightly or wrongly, that the main object to be kept in view was to grow good grass and clover, and if I got really good pasture, then other crops, so far as suitable for the soil, would follow in due course. I always break up my worst pasture,

and before breaking it up I try to improve it by slag if there are clover roots and by compost or dung if there are no clovers, and lime on the grass before ploughing, if convenient.

I began to see that ploughing must be done very carefully, and that the old-fashioned or common swing plough with medium boards and blacksmith-sharpened socks was the best for my purpose. The furrows, especially the stubble, I like turned over as whole as possible; if much broken they are liable to frost down and with a wet spring form a continuous pan that will not dry.

I early commenced using basic slag on the old grass, sowing 4 to 6 cwts. per acre, and missing a rig in every field to see the effect, which I found was very marked. I gradually increased the quantity to 10 cwts. per acre, with still better results, and found that 10 cwts. per acre for a start was much better than 5 or 6 cwts. applied at different times.

In sowing out grass I kept trying different seed mixtures. I tried cocksfoot, timothy, rough-stalked meadow grass, meadow fescue, crested dogstail, tall oat grass, burnet, chicory, kidney vetch and others, and came to the conclusion that the three first named were the only natural grasses worth sowing on the clay, and that crested dogstail became almost a weed, taking possession in a few years. I gradually reduced the amount of perennial rye grass, increasing the amount of cocksfoot and timothy. In 1913 I had the benefit of one of the College experiments, which proved that 14 lbs. of perennial gave a heavier yield of hay than 28 lbs. of perennial, the same quantity of natural grasses and clovers being used in both cases. I ultimately worked down to 9 lbs. of perennial and 3 lbs. Italian, or 12 lbs. perennial without Italian. One of the best mixtures is as follows:—9 lbs. perennial rye grass, 3 lbs. Italian rye grass (or 12 lbs. perennial rye grass without Italian), 10 lbs. cocksfoot, 6 lbs. timothy, 1 lb. rough-stalked meadow grass, 1½ lb. late-flowering red clover, 1½ lb. broad-leaved red clover, ½ lb. common white clover, 1 lb. wild white clover, ½ lb. alsyke.

I kept breaking up the poor and weedy pastures, taking one crop of oats and then struggling to get a turnip crop on part and bare fallowing the rest, sometimes with success and sometimes with failure—so far as the turnips were concerned—but always getting the land thoroughly cleaned. When the turnips were a failure I sowed rape broadcast and then horse hoed between the drills where the turnips should have been; this left any odd turnip that was there to grow. I found the ploughing down of the rape had an excellent effect on the grain crop following, sometimes even to the extent of making it lodge a bit.

Several times, under what I thought were favourable conditions, I have tried sowing out without a cleaning crop or a bare fallow, but have not found it a success. I have, however, got excellent grass after a heavy crop of beans, tares, etc., cut green, the land being cultivated for autumn wheat, and the grass and clover seeds harvested in on the growing wheat in April.

One of the best nurse crops for grass seeds is common bere. It is not grown much now, but it should be grown more than it is. It does not stand high off the ground even when a big crop. It is

earlier than barley, and grows more bushels per acre, and can be seeded with 2½ bushels. Being early off the ground is a great help to the young grasses, especially the clovers. This was well known a hundred and twenty years ago, and was recommended by Dr. Anderson of Monkshill, Udny, and Dr. Skene Keith of Keithhall and Kinkell in their reviews of agriculture in Aberdeenshire published in 1770 and 1810. These men also recommended highly all the best natural grasses we grow now. I fear the next generation of farmers forgot many things these men had learned!

Up to about 1912 or 1913 I found that, as I was putting my poor pasture fields into good grass, the loss was usually about £3 per acre when the grain crop sown with the grass seeds was realised, but that the hay crop following usually wiped off this loss and left me about the same amount in pocket, with a good pasture following a fine aftermath.

It is very important on clay soil not to allow the young grass to be pastured with sheep after the grain crop is off, and not with stock of any kind unless thoroughly dry. I have seen many fields of young grass ruined by sheep for the sake of a few shillings per day from some flockmaster. I always hay the whole of my new grass. It is very risky to pasture it. A wet night in May or early June, if the field is full of cattle, may poach the ground and ruin the pasture for years; even the aftermath I don't allow my cattle on to unless in exceptionally dry weather, and my sheep only up to the end of October. On a clay farm it is very necessary to have some old grass to put the stock on in very wet weather, otherwise you run the risk of serious loss by damaging beyond repair some of the younger grasses.

In December 1909, after reading an article on wild white clover by Professor Gilchrist in the *Journal of the Board of Agriculture and Fisheries*, I thought I would like to sow some. I ordered 25 lbs. at 2s. 9d. per lb. I sowed 1 lb. per acre along with my other seeds in 1910, omitting common white, of course. Next season I thought I would try it again, but the price being 3s. 6d., and plenty common white available at 10d. per lb., I left it alone. I forgot all about the wild white until July 1913, when some of my neighbours remarked on the amount of white clover in a particular field. I hadn't thought much about it even then. A gentleman from South America, who was staying with me, wanted to photograph some cattle in this field, and he showed me the photographs. I saw at once there was something more than usual in the clover. I looked up what I had sown in the field (I always keep a record of what I sow in the various fields, whether grain, seeds or manures), and I found it was where I had sown the wild white in 1910. I immediately ordered some more wild white to sow on my young grass the same autumn. The price was no object, I simply wanted the seed! This sowing in autumn was a fair success only, but in the grain crop that followed four years later, the rig that I had missed could be distinguished half-a-mile away. I estimate I lost £40 a year for at least three years through not continuing with the wild white when I began in 1910 and this on my grass alone, without calculating what I may have

lost on my grain crops. I have just (1920) harvested a crop of Red Sandy oats grown in the field where the wild white was sown in 1910. A few acres of the field had common white only, and I estimate the difference to be at least 2 qrs. grain per acre and double the straw in favour of the wild white portion.

Wild white clover is looked upon as a comparatively new discovery. Hear what the Rev. Alexander Farquhar, minister of Slains, Aberdeenshire, wrote in 1790, when giving an account of the Parish of Slains and describing the limestone gravel pits (crag shell gravel beds of Aberdeenshire).¹ He says: "Twenty or twenty-five years ago—that is, 1770 or 1765—they used this gravel for repairing the highways between Aberdeen and Peterhead, and some years after were surprised to see fine white clover growing very thick on those places of the road which had been repaired with this gravel, and every other place as bare as ever." This was nothing less than the real wild white clover which we now value so much. May there not be other and similar plants waiting development?

In making a new pasture I have obtained the best results by sowing 10 cwts. high-grade basic slag on the young grass as soon after the grain crop is off the ground in autumn as possible, using no nitrogenous manures for the following hay crop. I do this regularly now, and give other 5 cwts. every third year after. I have found a bare fallow one of the best methods of getting the clay land cleaned and prepared for making good pasture. It is an old method, but I do not think anything can beat it. A well-worked bare fallow clears the weeds every time. In preparing bare fallow for wheat, it should not be finally ploughed into rigs for sowing before the beginning of September; if done earlier, surface weeds get strong enough to withstand the winter frost, and interfere with the grass seeds in spring.

While working the land I give it 2 tons of lime carbonate, if this has not been previously applied on the grass. I finally plough it into 12 or 14 feet rigs in September, and sow 3 bushels Square-heads Master Wheat as early in September as I can get the ground ready, giving it 3 cwts. superphosphate or 4 cwts. slag when I sow it, and 1 cwt. sulphate of ammonia in the following March. I harrow it in April, before and after sowing the grass seeds, and roll it immediately. I have grown wheat (autumn sown) since 1914, and have found it quite a profitable crop, the average yield being about 4 qrs. per acre, varying from 5½ qrs. in 1914 to 2¼ qrs. in 1916, when the average yield of my other cereals was under 2 qrs. It has always given a large bulk of very useful straw. I learn from a person still alive that wheat was grown on this land after draining in 1856, but was given up about 1862 on account of a complete failure of the crop due to rust.

If you are cultivating a clay farm you do not require to go to the Stock Exchange for a little speculation: you get plenty of that at home! In 1915, for example, during a good season, I had about 100 acres of grain crop. I threshed about 600 qrs., of which I sold about 400. In 1916, with the same area in crop, I did not thresh 200 qrs. altogether, I had nothing to sell, and what

¹ See *Quarterly Journal of the Geological Society* for May 1882.

I had was not good seed. I had nearly all my seed to buy. Again in 1913 I had a 12-acre field under turnips, at least I did my best to grow turnips in it, but it was next thing to a failure. It cost £10 per acre to put them in, and the utmost value I could place on the turnips was £4 an acre, so I lost £72. This is one of the difficulties of estimating the cost of production. To which crop should the loss be charged? The following crop was common bere, with hay to follow, and the field has been pasture since.

The rent is a relatively small item when clay land is being cultivated, and unfortunately the cultivation is always most expensive in a bad season. In 1918 my wages bill converted into money was more than four times my rent (in 1920 it was more than five times). With prices as they are at present the clay farmer can take the risk of cultivating, but when grain is cheap, as it was in the eighties and down to 1912 or 1913, he simply cannot do it and pay his way.

The newer varieties of oats do not do well on the clay. They grow much too thin and sometimes fail altogether. I had this experience in 1918 with "Record." It was a complete failure, and I had to resow 7 acres with common bere. Potato oats usually do well after lea if the land is in good condition, but by far the safest oats to sow are Red Sandy, Scotch Birlie and Providence, or other small-grained varieties. They withstand grub and adverse weather conditions much better, particularly the Sandy, and this was found to be the case on heavy land all over the north of England in 1918. The straw from these varieties, especially the Red Sandy, is more valuable as fodder. I find it pays to have a change of seed from an earlier district every year.

I generally sow 10 to 12 lbs. grey peas per acre with part of my oat crop. This invariably gives a good return, as much as 2 to 6 bushels of peas per acre according to the season. You always have them in addition to the oats, and the oat crop is actually improved by them. They are a little troublesome with the binder if very thick, but before the days of binders it was a regular practice in the Aberdeenshire clay districts to grow peas amongst part of the oat crop, and they paid well.

As mentioned before, common bere is a very safe crop to grow on clay, particularly on cleaned land, but must be sown very thin; 2½ bushels per acre might give a very fine crop, while 4 bushels would be almost a failure.

I find the best manure for the grain crop on clay is one part of sulphate of ammonia to four parts of superphosphate, sowing 3 to 5 cwts. per acre according to the condition of the soil.

I generally grow a few acres of beans, and if the ground is dunged before being ploughed in autumn they are almost sure to grow well, but do not always ripen so well or so early as one would wish. We want an earlier variety of bean. I can learn of no improvement on the common field bean for 200 years. There's a chance for someone to produce an earlier field bean!

By the continued use of basic slag and lime great improvement has been effected not only in the quantity but also in the feeding value of the pastures. A few years ago I was using 4 to 6 lbs. of

cake per day for my feeding cattle all summer, with beans, tares, etc., on the grass in autumn, and the best live weight increase I got from April to October was 2'09 lbs. per day on two-year-old cattle. During the last three seasons (prior to 1920) I weighed average lots of yearlings, and without any artificial feed they made 1'9 lbs. per day on the grass from May to the middle of October. In 1920, 30 yearlings made 2 lbs. increase per head per day for five months.

I get over 2 cwts. live weight increase per acre on my best wild white clover pastures. This is exclusive of the winter grazing for sheep, which is considerable. I am also able to get all my lambs, and ewes as well, away fat by the end of October without any artificial feed at all, and I used to give them artificial regularly. I buy wholmouthed cast Cheviot ewes and breed them one season. I also buy lambs in good condition early in September and they go away fat off the pastures in November, also without any artificial feed. The average weight of the lambs in 1919 was 54 lbs. and the ewes 75 lbs., all away by 20th November. I run the ewes and lambs thinly along with the cattle. The two together graze the pastures much more evenly than either do alone, and more value is got off the ground.

The grass never fails, and the hay crop has never failed. It rarely comes under 2 tons per acre and goes up to 3 tons, and on one occasion yielded 3 tons 15 cwts. In 1919 a field of 13½ acres yielded over 40 tons of hay (baled in December), also an excellent aftermath and plenty clover. Cut again in 1920, the same field yielded over 30 tons of excellent hay with no additional manure.

The record of this field may be interesting. When ploughed up in 1915 it was an old and weedy pasture, part of it having been cross-ploughed out of stubble ten years previously and left in that condition to seed down itself. After a fair allowance of slag on the grass and an application of superphosphate and some sulphate of ammonia to the grain crop, it grew a good crop of oats. A second crop of oats in 1916 was a failure, yielding less than 2 qrs. per acre. In 1917 it was in turnips, was well dunged, limed, and plenty artificial manure was applied. Part of the turnips were fair, the balance being a failure. In 1918 it was sown with common bere. This yielded 4 qrs. per acre. The seeds sown with the bere were as follows:—12 lbs. perennial, 3 lbs. Italian, 10 lbs. cocksfoot, 6 lbs. timothy, 1 lb. rough-stalked meadow grass, 2 lbs. broad-leaved red, 1½ lbs. late-flowering red, ½ lb. alsyke, ½ lb. common white and 1 lb. wild white clover all per acre. The bere was early off and 10 cwts., 34 per cent. slag sown in autumn, 1918.

I have a timothy meadow of 5½ acres. I have now cut it for twelve years. I dung it every second year, and give it 1 to 2 cwts. sulphate of ammonia per acre the other year. This field has yielded from 10 tons up to 20 tons 4 cwts.—the latter in 1916 when my grain crops were a failure. The average yield would be over 13 tons for the field. I have put down more timothy; when hay gets cheap it will do for feeding my young stock in place of straw, if I have to reduce the area under cultivation.

You see how bright the grass side of the picture is compared

with the cultivating side, and although it has paid me to cultivate clay land during the past few years, I have always done so with the main object of getting the land thoroughly cleaned and limed and into really good pasture, as I fear the heavy clays must always be largely in grass unless grain is comparatively dear, and that the only economic way to farm clay land may be to grow a large proportion of grass, and above everything else to grow good grass. I know of no class of land that is capable of more improvement in grass than real hard clay. With lime, basic slag and wild white clover most of it could be made to produce over 2 cwts. live weight per acre on cattle and sheep in the summer grazing season. Very little of it is at present producing that amount.

I do not mean to say that nothing else but grass should be grown, but when fields are being sown out the possibility of their having to remain in grass for some time should be kept in mind. You will not hit the grass you would like every time, and will always have some fields worse than others that you could break up and improve, and when you do decide to break it up again, the better the surface you have to plough down the better your prospects are for the succeeding crops.

II. ENSILAGE.

From what I have written it will be realised that wet weather and turnips have to me presented the greatest difficulties. On the otherhand, I have never failed to grow a good crop of beans, tares, peas and oats for eating green.

In view of this I decided to try making this crop into silage for winter feed on the American method and to cut out turnips as far as possible. I visited several places in Norfolk where wooden silos had been erected, but I was not impressed by these for use in our exposed district, and decided to use reinforced concrete. It is practically everlasting and entails no cost for upkeep. I was told silage would not keep in a concrete silo, but I was prepared to risk this, and early in 1918 I erected a silo of this material at one of my farms, where the only accommodation is a fairly large partially open court. The silo is 16 feet in diameter, and 34 feet high inside, with walls 6 inches thick. The roof is also concrete, with an ordinary street man-hole cover let into it to take the bend of the blow-pipe for filling the silo. It was erected by a contractor in three weeks, the materials used being 60 tons crushed granite and sharp sand, 11 tons best Portland cement and about 30 cwts. steel for reinforcement. There are five doorways 5 feet high and 20 inches wide up the side of the silo next the buildings, and a fixed ladder for access runs up alongside the doorways, both being protected from the weather by a wooden shoot. Inside, the doorways are checked 2 inches at each side, and closed when filling as the material rises inside with half checked battens, 24 inches by 5 inches by 2 inches. The cost, including cartages, foundations, drainage, rain-water spouts from the top, and shoot for the material coming down into the turnip shed was £300, contracted for in November 1917.

The 15-acre field prepared for the silage crop of 1918 was after a vaval or second crop of oats. It was dunged 20 loads per acre the previous autumn and ploughed fairly deep, sown with 1 bushel beans, 2 bushels Scotch tares, $\frac{1}{2}$ bushel peas and 2 bushels oats—the beans being disk harrowed in, in March, and other seeds sown broadcast and harrowed in a fortnight later along with 6 cwts. superphosphate and 1 cwt. sulphate of ammonia per acre. The crop was quite a good one and the weight green was estimated at 11 to 12 tons per acre. It was cut and put into the silo in August.

The ground was ploughed and grubbed by the tractor which had worked the cutter and blower to fill the silo. It was cleaned by a bastard fallow and got $2\frac{1}{2}$ tons lime carbonate per acre, as it was my intention to sow wheat. The weather broke, however, and the state of the field became such as to make wheat-growing impossible, so I decided to take a second silage crop. The field had to be left until March 1919, when 3 bushels beans per acre were ploughed in, and a fortnight later 1 bushel Scotch tares, $\frac{1}{2}$ bushel peas and 2 bushels oats were sown broadcast and harrowed in along with 4 cwts. slag and 1 cwt. sulphate of ammonia per acre. The summer was unusually dry, but the silage crop of beans, tares, peas and oats was found to weigh from $12\frac{1}{2}$ to $14\frac{1}{2}$ tons per acre, the average being about $13\frac{1}{2}$ tons. The season, August and September 1919, having been favourable, the fifteen acres after silage was cultivated or bastard fallowed, sown with wheat and produced a good crop in 1920. The grasses and clovers have been an excellent take and a hay crop for 1921 is assured.

My experience of filling the silo in 1919 was as follows:—40 tons of clover hay, first year's timothy and red clover were put into the silo in July. The silo was filled up with 160 tons of the silage crop of beans, etc. This second filling began on the 19th of August, when there were pods at the bottom and flowers at the tops of the vetches. The total content of the silo was about 200 tons. The loss from evaporation and percolation was estimated by me to amount to about 20 tons or 10 per cent., thus leaving 180 tons feed. By leaving the crop to dry a little after being cut my experience is that the loss in the silo is reduced to 5 per cent., or the same result can be attained by mixing sufficient dry hay or straw with the green material when putting through the cutter to reduce the moisture content of the silage to about 75 per cent.

The cutter and blower, driven by an ordinary tractor, cuts the crop into $\frac{1}{2}$ -inch lengths and blows the material up a 10-inch galvanised-iron pipe over the top, through the man-hole into the silo, at the rate of anything up to 5 tons per hour. Buyers of cutters and blowers should be careful to get a cutter with not less than 15-inch throat and knives, as capacities of American cutters and blowers are based on green maize in American tons, which feeds and cuts much more readily than our mixture of beans, tares, peas and oats. I, unfortunately, had this experience, as I purchased an 11-inch cutter in 1918 and had to get it changed for the larger machine in 1919, and this requires a 20 to 25 horse-power tractor to drive it.

The filling requires no special skill, only a reasonable amount of care to see that the material is well tramped, particularly round the outsides, and that the doorways fit tight to exclude the air. A sheet of tarred paper or thin felt should be used behind the doorways if there is any doubt, as any air getting in will spoil a considerable amount of silage round about. For the same reason it is better to be tramped daily for a week or ten days after filling has finished as it will sink considerably, and in doing so tends to draw away from the sides and let the air down, causing waste. I have got over this difficulty by using a covering of 6 inches of dry peat dust, and have no waste beyond the inevitable 6 to 9 inches on the top; below that there should be no waste.

The labour required for filling the silo is as follows:—

One man and two horses in the field cutting the crop with a mower.

Three men and three horses with lorries carting in the crop.

Two men forking on to the lorries in the field.

One man attending hired tractor.

One man feeding cutter and blower.

Two men inside silo distributing and tramping the silage. (If a third could be spared so much the better.)

If the field were any distance away, another man, horse and lorry would be required. On the other hand, if the tractor were owned, the attendant could feed the cutter. It is economical and saves the loss caused by the running off of the excess moisture to keep the mower going a day or so in advance to allow the crop to dry a little. By leaving intervals, say three days, between filling the silage gets time to heat and settle, and the silo holds more, but I am sure the more economical way would be to have the silo 8 or 10 feet higher, and make a start and go ahead until it is full.

I believe this is the method now being adopted in the United States, where a gang of men with a cutter and tractor fill a number of silos in a district. So long as the men can work outside, it can be filled wet or dry, and it is immaterial whether the silage heats or not; both sorts are equally good. Should I build another silo, I will certainly make it 8 or 10 feet higher than my present one. For convenience in feeding and to save extra handling the silo should discharge into the feeding or turnip shed, in which case the cattleman need never go outside in bad weather.

I purposely avoid putting values on the cultivating, manuring, seeding and filling, as costs are vexed questions, but individuals can calculate the costs as applicable to their own conditions, and compare them with the cost of growing turnips on clay land, keeping in mind that with a silage crop, such as I have described, they are dealing with a certainty—even with ordinary care—and that turnips on clay are problematic, even with the greatest care and experience. A man when feeding with silage can tend many more cattle than when feeding with roots. My man tends sixty cattle and forty pigs and has less than five hours' work daily.

A series of samples was taken when filling the silo in 1918 and 1919, also when feeding to the stock during winter. The

following table (I.) shows the results and also the value of silage for feeding compared with turnips¹ :—

TABLE I.

Crop for Silage.	CONSTITUENTS.						Food Units.
	Oil.	Albu- minoids.	Carbo- hydrates.	Fibre.	Ash.	Moisture.	
I. Cloverly Hay and Rye-grass.	·69	3·32 ₇₄	11·38	11·68	2·21	70·72	21·4
II. 3 bush. Beans 1 bush. Tares $\frac{1}{2}$ bush. Peas 2 bush. Oats	·54	2·36	6·44	4·08	1·43	85·15	13·7
III. Same mixture as No. II., taken from Silo in Dec- ember. ...	1·01	2·82	8·53	7·52	1·45	78·67	18·1
IV. Average Com- position of Turnips. ...	·25	1·00	6·00	1·00	·75	91·00	9·1
V. Same as No. II., but calcu- lated with a moisture con- tent of 78 per cent. ...	·77	3·38	9·24	5·85	2·05	78·70	19·6

No. I. is from the bulk of 40 tons of green rye-grass and clovery hay when being put into the silo in July.

No. II. is from the bulk of 160 tons beans, tares, peas and oats all freshly mown as they were put into the silo in August.

No. III. is a sample drawn from the bulk of No. II. as being fed in December after being four months in the silo.

No. IV. gives the average percentages of constituents in a crop of turnips, the figures given being for crude "and not digestible" constituents. Of course the food values as given are only approximations, since it is admitted that until the more valuable constituents of albuminoids and oil are known the real food values cannot be given. It is interesting, however, to note that weight for weight the silage is much more nutritious than turnips—nearly double.

In order to make a comparison, the percentages given in No. II. were recalculated on the basis that No. II., after having been in the silo until December, had the percentages of moisture shown in No. III.—namely, 78·70. The recalculated figures on this basis are given in No. V. and show that there has been a loss of almost 2 food units by percolation. A sample of the liquid

¹ These analyses were made by Dr. J. F. Tocher, Chemist to the Highland and Agricultural Society of Scotland.

as it percolated from the silo for about a fortnight after completion of filling in 1919 gave the following analysis :—

TABLE II.

	Oil.	Albumin-oids.	Soluble Carbo-hydrates.	Ash.	Water.	Food Units.
Liquid from Silo	0.39	2.08	3.52	1.57	92.44	9.7

I have mentioned in another part of these notes that this loss can be avoided by allowing the crop to dry somewhat after cutting before putting it into the silo, in which case I am satisfied the food value of the matured silage from mixture No. II would be retained at 18 to 19 food units.

The silage has no unpleasant smell, whether sour or sweet (*i.e.* heated or otherwise), and I have found no difficulty in getting the cattle to eat it. They take it greedily from the first, with absolutely no waste. In season 1918-1919 I fed it to store cattle, mostly in-calf heifers, commencing with 25 lbs. per head per day, and increasing the quantity to 35 lbs. along with 1 lb. fish meal and 1 lb. ground oats with straw, of which they consumed a fair quantity. They thrive well and did well on the grass. I also tried the silage with my cows in spring with excellent results.

In season 1919-1920 I had forty-five weaned calves and fifteen in-calf heifers on the silage. They were taken off the grass on 1st November, and started on the silage at once, getting 40 lbs. per head per day, fed at three times. This quantity seems to be about the limit, for small cattle at least, as the greedy ones showed signs of getting hoven with more, although they would eat more. As a matter of fact, never on any occasion was a particle left. They had all the oat straw they cared to eat, and they consumed very little comparatively, certainly less than half what they would have done with turnips, and much less than with the smaller allowance of silage in 1918-1919.

They have access to water all the time, and drink quite a lot. No cake or meals were used until 1st January, when they got 1 lb. fish meal per head per day mixed with the silage. The older cattle and the stronger calves got quite fat by spring. The sixty were in one lot, as I had not the convenience for grading and dividing them up and naturally the strongest ones did best. After March the in-calf heifers were gradually drafted out, until at 1st April there was nothing left but the yearlings. On 1st May fifteen of the yearlings were put out to grass, and thirty average ones kept in to finish out the silage, which they did on 15th May, when they also were put out to grass.

The thirty yearlings (fifteen bullocks and fifteen heifers) were weighed and marked in the presence of two well-known Aberdeenshire farmers on 11th May, and the average weight of the bullocks was found to be 4 cwts. 3 qrs. 15 lbs., and of the heifers 4 cwts. 1 qr. 15 lbs. The average age was then under thirteen

months. The same gentlemen weighed them again on 4th October—146 days later—when the result was that the bullocks averaged 7 cwts. 2 qrs. 12 lbs., and the heifers 7 cwts. 0 qrs. 5 lbs., an increase on the former of 305 lbs. and 298 lbs. on the latter, or just over 2 lbs. per head per day for the lot. This shows that cattle can do fairly well after silage, and also that they can do well on wild white clover pasture, on which they grazed all the time, and should dispel the idea a few farmers still have that cattle are not fond of clover and do not do well on it!

In feeding the silage it must be kept in mind that once a beginning is made a couple of inches require to be taken off all over the top every day or second day, according to the mildness of the weather, otherwise the silage gets mouldy. Should it not be all required in any season, a covering of chaff, peat dust, mill dust or such material put over it immediately you stop using it will make it keep over to next season; in fact, it will keep indefinitely if the air is kept from it. You can, of course, refill above what is left over.

The 1919 silage crop, it will be observed, followed three cereal crops in succession; it was the best crop of the four, and the land was left free from weeds. On real clay land it is not safe to make up your mind to any fixed rotation! I am of opinion that the silage crop could be grown for a number of years in succession on the same ground. My silage crop for 1921 will be in an oblong field of 15 acres, at the top end of which the buildings and silo are situated. This field, which is poor red clay, "putty at one season and bricks at another," was poor grass and has been poor oats two years in succession. During the past forty years it has not grown one good crop of turnips, but I have no doubt whatever that, with a fair application of farmyard manure and some artificial manures in spring, a 10 to 13 ton crop of silage is assured, and with 4 bushels beans per acre in place of 3, and a favourable season, I am hopeful of ultimately getting the silage crop in this field up to 16 or 18 tons per acre, which would equal in feeding value 30 to 40 tons of turnips.

I do not suggest that on farms where turnips can be grown with regularity and success silos should be built, but were it not for the initial cost it would seem to me that silos on heavy soil farms would soon become fairly common, and there is no doubt that on practically any fair-sized dairy-farm they would be a great asset, especially if large enough to provide a reserve to carry over such a summer as 1919, when they would have served to tide over the shortage of grass. I had no scarcity of grass on the clay. The silage kept my cattle until the grass was well up; and it was the best grazing season I ever had. Silos at once provide a freedom of cropping impossible with turnips, and save a lot of carting in winter when land is wet. Moreover, the nature of the crop enriches the land.

Of course concrete silos cannot be removed, but once their value is recognised they may on suitable farms become a scheduled improvement under the act. In my own case I am satisfied I can write off the cost in three or four years. Some of my friends in Northumberland, who started building after me

in the spring of 1918, have erected their third concrete silo, 18 feet by 40 feet, holding nearly 300 tons each. This is on cattle and sheep-feeding farms, and they consider the greater success has been with the sheep.

The use of the silo makes possible, and in my experience profitable, the cultivation of land which otherwise it would not pay to break up.

COMMON WEEDS.¹

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WEEDS may be described as plants growing in the wrong place. They need not be useless or harmful plants, but if they enter into competition with a crop plant, so as to interfere with the roots in the soil, or the leaves and stems in the air, then measures must be taken to remove them. The popular opinion that arable land dirty with weeds is a sign of careless farming is on the whole correct, though it is true that some soils are favourable to weeds, or it may be that the careful farmer is struggling through the proverbial seven years' weeding that follows one year's seeding. There are, however, other reasons why it is necessary to keep the land free from weeds if it is to produce the best possible crops. It is easy to see that a rank growth of weeds smothers the crop, and even a little knowledge of plant nutrition will convince that the weeds are using up valuable plant food. The bad effects extend to the crop sold away, for no buyer will give the highest price for corn mixed with weed seeds, and a farm producing dirty corn will soon get a bad name. If the farmer tries to overcome the defect by extra screening, the saleable grain is reduced and he is left with a quantity of hen corn or pig food, and a considerable risk that the weed screenings will return to the land carried in the farmyard manure. The presence of weeds in seed-corn is even more serious—say in oats from Scotland, a source of revenue not to be despised by the enterprising farmer. The buyer of seeds nowadays is much more careful about weeds, and there is a more careful scrutiny of seed samples through the seed-testing stations, so that an adverse report as to impurities is sure to affect the price offered. Clean land is necessary to produce clean samples of rye-grass and turnips, and if this can be attained only by slow and costly hand-pulling of weeds, the grower will soon lose any extra profit from saving seed. These notes on weeds refer especially to Scottish farms, and are based on observations, supplemented by useful material culled from various sources. Weeds have often been written about, yet within recent years something has been added to knowledge. One of the more recent works of reference is H. C. Long's text-book,² which may

¹ This is the first instalment of an article on the subject, which will be followed by articles dealing with other farm pests.

² H. C. Long, *Common Weeds of the Farm and Garden*. 450 pages, 103 illustrations of plates, etc., 3 plates illustrating seeds of 76 weeds, and bibliography. London, John Murray. 1910.

be regarded as a complete record of weeds up to date. It includes full descriptions, with illustrations, of the more widespread British weeds arranged in botanical order, while the recommendations for prevention and treatment of weeds in arable land and grass land summarise the information contained in a number of earlier works quoted in an extensive bibliography. Professor A. N. M'Alpine's unique acquaintance with Scottish farming is the foundation for numerous contributions.¹ A noteworthy book on weeds has appeared while the present paper was in preparation. Miss W. E. Brenchley, botanist of the Rothamsted Experimental Station, has broken new ground² as the result of what is probably the widest survey of weeds yet attempted. The conclusions presented are based on a weed analysis of hundreds of fields; for instance, the field or creeping thistle was recorded in 812 fields. The counties examined are in central England, but the results may be applied in other parts of Britain, and they have been used here, as indicated in most cases by acknowledgment. This survey has thrown new light on the association of certain weeds with heavy, light, chalky or other soils, also on the weeds that follow particular crops, and other weed problems have been subjected to controlled experiments at Rothamsted.

The illustrations used have been supplied through the courtesy of Miss Brenchley and Mr. H. C. Long, and their respective publishers, also of Messrs. Blackie & Son for the *Standard Cyclopaedia*. Our acknowledgments are extended to these all the more because illustrations greatly simplify the not too easy task of describing plants in simple language.

Colonisation of Bare Land.—A field, garden or other recently upturned land becomes in time populated with plants. If the soil is good, colonisation occurs soon, but if it is subsoil, for instance, a spoil bank, a longer time is required. An examination of the plants on recently turned soil reveals a definite succession. During the first summer the conspicuous plants are annuals, whose shoots flower once then die away, leaving only seed to propagate the race. Closer inspection will show, in addition, a number of non-flowering plants which during the first autumn, winter and spring will continue to grow and prepare for flowering in the second year or later. By the second summer the ground is largely occupied by perennial plants, adapted to survive many years and to produce many crops of seeds. The annuals will be limited to bare spots where their seedlings can find a place. This process, repeated for a few years, results in the herbage seen in an old grass field where the plants are almost all perennials. Allowing the arable fields to run wild or "tumble down to grass" was a feature of old-fashioned farming, and can still be found in a few outlying districts.

Arable land under regular cultivation offers facilities for weed

¹ A. N. M'Alpine and R. Patrick Wright, *Weeds and Weeding*. Trans. Highland and Agricultural Society of Scotland. Fifth Series, vi., 1894.

A. N. M'Alpine, Articles on Weeds in *Standard Cyclopaedia of Modern Agriculture*. 12 vols. London, Gresham Publishing Co. 1908 to 1911.

² W. E. Brenchley, *Weeds of Farm Land*. 239 pages, 42 illustrations. London, Longmans, Green & Co. 1920.

development, but on the other hand it presents difficulties. The soil is probably fertile, so that new plants root quickly, and as arable land lies for months without crops or thinly covered, the weeds have free exposure to light. On the other hand, the regular sequence of ploughing or cultivation operates against the weeds. No plant can become a noxious weed unless it is prolific in seeds or in some other mode of propagation. Hardiness against seasonal changes, and capacity to survive the competition of the crop plants are also necessary. This accounts for the limited number of really serious weeds, say about 100, in comparison with the total number (say about 1500) of Scottish plants. Many plants called weeds occur on waste ground, or along roadsides, but only now and then do they become abundant weeds in fields. The stubborn resistance of the commoner weeds lies in some feature of their structure, hence in dealing with them it is important to find out the stages in their life history when they are weakest.

How Weeds reach the Land.—The origin of the plants that appear on newly turned land is to be sought in two directions: they arise from seeds, etc., conveyed to the land, or they were in the land already. Natural colonisation, say of a spoil heap, depends on such agents as wind that blows seeds, etc., animals that carry "burrs" or sticky seeds on fur, wool, or feathers, or birds that eat seeds and disperse them with excreta. In the case of ploughed land, colonisation is often much quicker, as in the following example. A small field was ploughed out of the natural grass of a hill farm, where the nearest cultivated land, the shepherd's garden, is about half-a-mile away, while a neighbouring field of old ploughland had not been broken up for about fifty years. The new field was ploughed up in early winter, again in spring, and a crop of cabbages for sheep was raised on artificials alone, no farmyard manure being applied. An analysis in the following September showed abundance of weeds belonging to 23 species, including grasses. Twelve of these were recognised in the surrounding natural grassland. The remaining eleven included hemp-nettle (very abundant), three species of polygonum (abundant), spurrey, field pansy, small lady's mantle (common), and some plants of timothy, tall oatgrass, spear thistle, and silverweed. The only explanation for the occurrence of these weeds was that hay and oat-straw were brought to the hill farm and fed to sheep netted in the new field during the previous winter.

The following ways by which arable land may be colonised have been established after reliable observations:—

- (a) *Farmyard Manure.*—Experiments have proved that large numbers of weed seeds pass uninjured through the digestive system of farm animals. In one case out of a known number of seeds mixed with a cow's food 51 per cent. of ribgrass plantain and 26 per cent. of mayweed were afterwards germinated from the excreta.¹ The experiment of burying weed seeds in packets of farmyard manure in the cattle courts has often been repeated, and considerable numbers of seedlings have appeared when

¹ See also W. E. Brenchley, *Weeds of Farm Lands*, p. 74.

the contents of the packets were mixed with soil. Most gardeners and allotment holders could give examples of weeds new to the ground being introduced with a load of farmyard manure; in our own experience thousands of goosefoot seedlings arose in this way. The greater prevalence of weeds in fresh manure, not rotted, is too often observed to need experimental proof.

- (b) *The Threshing Mill*.—Even in a clean crop it is astonishing how many weed seeds appear in the screenings. These are not easily disposed of, and generally they are either collected into heaps, left in the stackyard, or wheeled into the manure heap. In each case there is a considerable risk that many will return to the land.
- (c) Hay-loft sweepings containing weed seeds are equally hard to get rid of. Sometimes they are used to sow temporary or permanent grassland, so that good seeds and noxious ones all go back to the land.
- (d) Seeds used for sowing may contain impurities. The smaller seeds such as grasses and clovers may be obtained from land not perfectly clean, so that weed seeds are also harvested. If the weed seeds are about the same size as the true seeds, it is not easy to clean the bulk, and cleaning is expensive. What becomes of the cleanings? It does not follow that every impurity in seed corn is a weed, but docks, sorrels and geraniums are common noxious weeds that may often be found in samples.
- (e) Feeding stuffs may convey weed seeds, as in the fodder for sheep already referred to.
- (f) Mud carried on carts and implements has been shown to convey seeds from one part of the farm to another.

Annual Plants occurring as Common Weeds.—It is more important for the grower of plants to be able to read the life history of a weed than to know its name, though a name is useful. Any plant may become a weed if conditions are favourable, and in a new country new weeds will be found. The treatment of weeds becomes simpler when it is noted that many common weeds of arable land are annuals, or the seedling plants of perennials that may be checked by the same operations as for annuals. There are, however, certain perennials that are pernicious weeds (buttercup, creeping thistle, coltsfoot, dock, twitch or wrack grasses, etc.) and require special treatment, according to their mode of growth.

Annual weeds may be distinguished by one or more of the following features:—

- (1) A simple root system, generally a taproot with lateral rootlets and fibres, but sometimes there is a mass of rootlets without any distinct taproot. Seedlings of perennials also show the simple root in the younger stages.
- (2) The vegetative system consists mainly of leaves, frequently forming a rosette close to the ground. Leaves and roots supply the needs of the young plant, and stems only appear later as erect branches or trailing shoots that bear the flowers.

- (3) The flowering branches appear early in true annuals, often within a few weeks after the leaves, and they continue to bear flowers and to ripen fruit till harvest or till cut down by frost.
- (4) Annual plants flower only once, and the flowering period generally finishes before winter, so that during winter only seed remains. This is not universally true in the open British winter, because several annuals (chickweed, groundsel, etc.), probably autumn seedlings, remain green all winter. Seedlings of biennials and perennials often maintain growth during the winter.

There is no hard and fast line between annuals and perennials. Any annual may become perennial if flowering is prevented, thus the annual poa grass becomes a perennial on a lawn constantly mown, and other annuals may be long-lived on a closely grazed pasture. Some weeds, such as horse daisy, in favourable places continue to produce new shoots from the base, so that the plant may flower for several years, though each shoot dies away after flowering once. In first-year grass mixtures, weeds like geranium, corn pansy, field madder and the spear thistle form leafy plants one season, which flower after remaining green all winter.

Flower colour has been adopted in grouping the commoner annual weeds in the following descriptive notes. Weeds can be recognised by their seedling and older leaves, but this is better done by experience gained by personal observation of the living plants. It is nearly impossible to describe leaf-form in simple language, and leaves vary so much in size, and even in shape, according to soil and season, that the illustrations only partially suffice. The flower is the natural basis of all botanical classification, because the flowers though variable are less influenced by external conditions. It is usual in describing plants to follow the botanical system,¹ but a grouping according to colour may be convenient for those interested in weeds alone. The descriptive notes are intended to aid in identifying the weeds; treatment and prevention are dealt with later.

I.—ANNUAL WEEDS WITH YELLOW FLOWERS.

Charlock, Runch and Wild Turnip.—The common yellow weed of arable land is also known as skellies, ketlock, wild mustard and by many another name, according to the district. The local name generally covers two or three distinct plant species, which vary in abundance from field to field. They all bear a resemblance to turnip, but can be identified by attention to the differences given below.

Charlock (Fig. 1) is one of the "Brassica" family, which includes mustard, cabbage and turnip. The botanical names *Brassica arvensis*, *Sinapis arvensis*, and others used lead to some confusion, but they indicate the same plant species. Charlock has lemon-yellow flowers, similar to those of white-fleshed turnips, but differing from the orange-yellow flowers of yellow-fleshed turnips.

¹ See H. C. Long, *Common Weeds of Farm and Garden*.

A distinguishing feature of the flower is the green sepals spread out horizontally (Fig. 1 (r) and Fig 2 (r)). The fruit is like that of turnip, a long narrow capsule with a terminal beak, and the ripe fruit splits from bottom to top, so that charlock is distributed mainly by seeds. The seeds are very like turnip seed, not easily distinguished by skin-colour, but charlock seeds have a strong flavour of mustard when chewed, whereas turnip seed has mainly an oily taste. Charlock leaves are rough, not so much from coarse hairs as in runch, but because they are crinkled in texture. The earlier leaves at the base of the plant are somewhat lobed, but the higher leaves are not lobed or only slightly, thus differing from the upper lobed leaves of runch. In the young stage, at the turnip - thinning season, turnip leaves are about equal in length and breadth, whereas charlock has the blade about twice as long as broad.

Runch (*Raphanus raphanistrum*) has leaves distinctly rough with hairs especially on the lower surface. The larger basal leaves are more lobed than charlock or turnip, the blades being about twice as long as broad, and the upper leaves are also lobed. The flowers are larger and paler than charlock, sulphur-yellow

or whitish, sometimes streaked with blue. The fruit is the best distinction. When young it is not unlike charlock and other "Brassicas," but as it matures the fruit becomes "beaded" (see Fig. 2), and the beak remains thin and slender. The beaded appearance is produced by the fruit segmenting across, so that each seed, enclosed in a segment of the fruit wall, becomes separated from the next segment by a thin cord; this is better seen in dry fruits than in green ones. At maturity the fruit breaks up into pieces of one or more "beads" each containing a seed, so that runch is dispersed by one-seeded pieces of fruit, not by seeds as in charlock. The runch "beads," being larger, are not so likely



FIG. 1 — CHARLOCK. ROOT SYSTEM, LOWER AND UPPER LEAVES, ETC.

(r) Flower, petals removed to show sepals; (2) petal; (3) fruit (Standard Cyclopædia of Agriculture)

to occur in turnip and other small seeds, but are frequent impurities in oats and other grain, and because of their size they are not easily screened out. The runch fruits are straw-coloured, the seed inside being light brown, like that of garden radish, and larger than charlock or turnip seeds.

Wild Turnip (*Brassica* spp.).—This weed is not so common, although a considerable number may sometimes be found in looking over the late-flowering yellow weeds in autumn, in turnip or potato crops. The flowers and leaves are variable, the fruit is of the "Brassica" type. The leaves are usually smooth and waxy,

and it has been noted in spraying for charlock and runch that the spray did not adhere, so that the wild turnip plants survived when the rougher-leaved yellow weeds were destroyed. The origin of the wild turnip may be impurities in seed, or the small turnips left from a previous crop, or the "rogue" turnips which "neck" and do not form tubers; flowering plants from these sources would produce seed for later years.

Charlock and runch occur on every class of soil and in every crop. According to Miss Brenchley's observations in England, charlock is commoner on heavy soils and not quite so frequent on lighter soils; it flourishes better in oats and

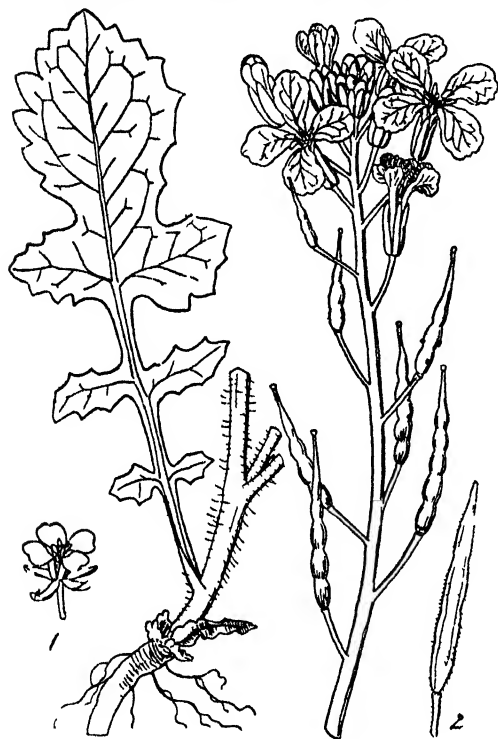


FIG. 2.—RUNCH, BASAL LEAF, FLOWERS AND BEADED FRUIT.

(1) and (2) Charlock flower and fruit (*Standard Cyclopædia of Agriculture*).

wheat than in other crops. Several Danish observers record runch as partial to soils deficient in lime and other bases, whereas charlock follows the more basic soils, but its frequent occurrence in the same field with runch seems to indicate that charlock is not too particular as to soil. The seeds are difficult to kill. Many cases are recorded of charlock appearing on land ploughed from old grassland that has been in grass thirty or more years. The seeds are not likely to be carried by wind because of their size and shape, hence care should be taken not to convey them to the field with farmyard manure. As annuals they are dealt with by the general methods

described later. Good results have been obtained by spraying methods.

The order Compositæ is represented among the yellow-flowered annuals by the following four common weeds:—

Groundsel (*Senecio vulgaris*) is a persistent weed on all kinds of soil. Amongst the crops, it is more likely to be troublesome in young grasses and clover. It is a shallow-rooted annual with deeply cut leaves and a stem about a foot high. It grows so rapidly that from early in the year till late in autumn flowers, seeding heads and seedlings may be found, hence the weed is not easily checked. The flower-heads are small, $\frac{1}{2}$ -inch diameter, and without the conspicuous marginal florets seen in ragwort, the perennial weed *Senecio*. The one-seeded fruits arise from each floret in the head, and are provided with a downy pappus which assists in dispersal by wind. The small ribbed fruits ($\frac{1}{10}$ -inch long) without the pappus have been found in the crops and excreta of birds, also in mud and in manure. The weed is checked by frequent cultivation. It is not specially sensitive to spraying with copper salts, but is severely damaged by kainit or common salt.



FIG. 3.—ANNUAL SOW THISTLE.

(*Sonchus oleraceus*.)

(Photo by H. C. Long.)

Sow Thistle (*Sonchus oleraceus*) is a tall weed with conspicuous yellow flowers, often standing above the corn

(Fig. 3). The annual species closely resembles the perennial one (*Sonchus arvensis*), but it has a deep fleshy taproot with abundant milky juice, and is distinct from the widely creeping "wrack-like" underground stem of the perennial. The large yellow flower-heads, the slightly spiny leaves, and the tall hollow stem with milky juice make identification of the sow thistles fairly easy. The seeds or fruits are brown, fairly large ($\frac{1}{4}$ th inch long), flattened and provided with a downy parachute, but as this is easily detached and the fruits rather heavy, they are not probably carried very far by wind. When sow thistle occurs in corn it is easily seen, so that

hoeing or hand-pulling before flowering may be used to check it; if this is not done till flowering has begun the uprooted plants, like most Compositæ, will probably ripen their fruits before being dug up.

Nipplewort (*Lapsana communis*) is hardly a noxious weed, but it is common about gardens and waste places, and inquiries as to its name are frequent. It may grow as tall as sow thistle, but is distinguished by the thinner, harder stem with only traces of milky juice, the less lobed leaves, and the much smaller flower-heads, $\frac{1}{4}$ -inch diameter. The long slender fruits may be found in grass seeds.

Corn Marigold (*Chrysanthemum segetum*) is like ox-eye daisy or horse gowan, but has all parts of its flower-head orange-yellow; the ox-eye and other large-flowered daisies have a yellow centre of closely crowded disc florets, surrounded by a fringe of long white ray florets. Corn marigold is a conspicuous weed with its large flower-heads, about 2 inch diameter, borne on long stems as high as the corn. As a weed it is uncommon in the Lothians and other intensively farmed districts in Scotland, but in the upland glens of the Highlands and among the smaller western farms (*e.g.* Argyllshire) corn marigold becomes a serious weed. It is favoured by light sandy or gravelly soils deficient in lime, so that, like spurrey, it may be regarded as an indicator that the land requires basic manures, lime or basic slag. That it can be suppressed by liberal manuring and good cultivation, including frequent root crops, can be seen by its scarcity in the fields of the more progressive farmers. The effect of manuring may not be seen immediately, because the yellow barrel-shaped and ribbed fruits or "seeds" are produced abundantly, and are known to preserve their vitality in the soil for years, hence the value of frequent cleaning crops.

Yellow Mayweed, a variety of scentless mayweed (*Matricaria inodora*), has no white marginal florets, hence the flower-heads are greenish-yellow (see Mayweed, under white-flowered annuals).

II.—ANNUAL WEEDS WITH WHITE FLOWERS.

Horse Daisy, Horse Gowan, Chamomile or Mayweed. The North Country name of horse gowan includes all the large-flowered Composites with a yellow centre and white fringing ray florets, as distinct from the smaller flower-heads of the true daisy or gowan. Excluding the ox-eye daisy or marguerite, a tall perennial of grassland and grassy places, there remain four annuals which may be weeds in arable land. All four are so similar that experienced botanists may confuse them. The weeds have the same finely divided leaves as the true chamomile, a perennial medicinal herb sometimes cultivated in gardens for its sweet-smelling flower-heads, but none of the weeds have the scent so strong.

Scentless mayweed (*Matricaria inodora*) is the commoner weed. It has little or no scent when crushed, and the tiny fruits are four-angled. A variety in which the white fringing florets are

absent was a rare plant thirty years ago, now it may be found in almost any stackyard or about field gates often in great abundance.

Wild chamomile or scented mayweed (*Matricaria chamomilla*) has a faint odour of chamomile, and is not so common (Fig. 4). These two species of *Matricaria* have the ripening flower-heads with a cavity inside.

Corn chamomile (*Anthemis arvensis*) has a faint smell of chamomile, but is distinguished from the wild chamomile by the flat-tish solid flower-head and the numerous small chaffy scales embedded amongst the disc florets (Fig. 4 (1) and (2)). The fruits are conical, with wart-like knobs.

Stinking chamomile (*Anthemis cotula*), with a strong offensive odour when bruised, is an uncommon weed except on heavy land.

These horse daisies are comparatively shallow-rooted and are fairly well kept in check by vigorous cultivation and cleaning of root crops. They do not thrive in tall corn except in thin places and round the field margins. As they tend to grow vigorously in stubble after harvest, even with severe night frosts, they tend to become aggressive in first year "grass seeds." The fruits occur as impurities in clover seed.



FIG. 4.—WILD CHAMOMILE (*Matricaria chamomilla*), LEAVES AND FLOWER-HEADS. (1) Four florets, each with a scale, of true Chamomile (*Anthemis nobilis*.) (2) *Matricaria* florets, no scales except near margin of head. (Standard Cyclopaedia of Agriculture.)

Chickweed (*Stellaria media*). -The name chickweed is used for several species of plants, which have a dwarf growth, small white flowers and seed capsules containing minute rough seeds much liked by birds. They are included here amongst the annual weeds because they begin to flower in the seedling stage as many annuals do, though they have some features of perennials.

Common chickweed with smooth bright green leaves may be found all the year round on any cultivated ground, generally flowering profusely and producing numerous seeds even in winter. As a weed it becomes more conspicuous in root crops, in turnips left in the field in winter, or among potatoes left for some weeks after the haulms have died. The seedlings appear at any time in the year and soon branch to form tufted plants with long branches trailing on the ground and sometimes rooting, so that if left undisturbed a single plant will cover a square foot or more. The rapid growth enables chickweed to become a weed in root crops; new plants spring up after the last cultivation of the crop, and flourish because so many other weeds have been destroyed in the cleaning. The seeds are common impurities in clover seeds, thus introducing the plant into young grass mixtures, but it does not persist as a weed amongst the older grass.

Mouse-ear Chickweeds (*Cerastium*), also common impurities in clover seeds, flower within the first season like annuals, but the creeping stems may be found in old grassland, hence they are perennials; more than one species is often present. Mouse-ear has hairy leaves and stems, while true chickweed is smooth except for a line of hairs on the stem, a feature that distinguishes *Stellaria media* from other stellarias. The white flowers have five petals, each split almost into two in chickweed, but only notched in cerastiums. The latter have fruit capsules twice as long as the calyx and with 10 teeth; the chickweed has shorter capsules with 6 to 8 teeth. The chickweeds are shallow-rooted plants to be treated by vigorous cultivation, but are not easily eradicated because new seedlings soon come up.

Spurrey (*Spergula arvensis*), often called "yarr," belongs, like the chickweeds, to the order Caryophyllaceæ. It has minute white flowers that open only in sunshine and are not conspicuous, so that the plant might be grouped amongst those with greenish flowers. The plant is about one foot to eighteen inches high, but it grows so rapidly and forms such close tufts that it can smother any young crop. The leaves are narrow, and the uncommon arrangement of twelve to twenty at each node is almost sufficient to identify this weed (Fig. 5). Spurrey is rough and sticky, with an unpleasant smell, very strong when large rank patches die down towards autumn. Numerous seed capsules are produced, each containing the characteristic seeds ($\frac{1}{16}$ -inch diam.), black and flattened, with a white rim or "halo." When spurrey is common, the seeds give a distinct black colour to the threshing mill screenings. They are said to be good food for poultry. Spurrey is more abundant on moory, sandy or light soils, especially acid soils deficient in lime. In Miss Brenchley's investigations, spurrey was observed 218 times, never on chalk or calcareous soils, often dominant on sandy land, and common on reclaimed peat. The recommendation to apply lime against spurrey has sometimes succeeded, but other experiments have not led to a cure.¹ Where the land contains many seeds of spurrey an immediate disappear-

¹ See H. C. Long, *Common Weeds*, p. 74.

ance is not to be expected, but a dressing of 10 to 20 cwts. of lime per acre, or 10 cwts. basic slag, would be a good beginning towards improving the general fertility. Spurrey is not often abundant on well-farmed land, because it is suppressed by the better crops of corn, and probably to some extent by other weeds that do not thrive on acid soil. Spraying with copper sulphate (5 lbs. per 10 gallons water, or even 3 lbs.) has been found effective in preventing the weed seeding. Sheep grazing has been recommended

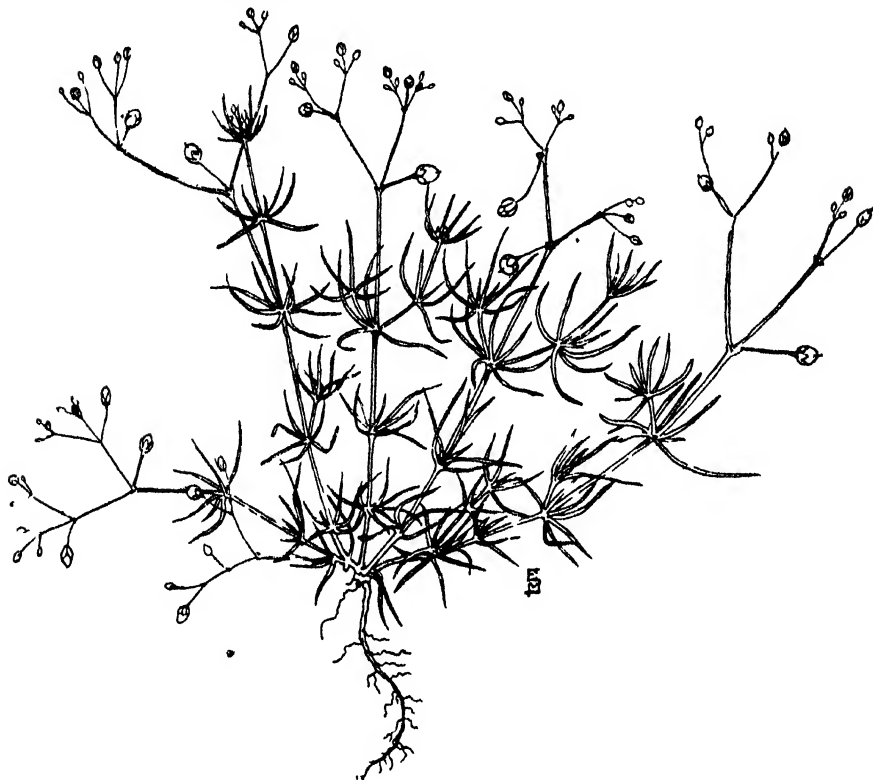


FIG. 5.—SPURREY (*Spergula arvensis*).
(Weeds of Farm Land, W. E. Brenchley.)

for excessive spurrey in young grass, but unless the land is heavily stocked the sheep avoid the spurrey.

Cleavers (*Galium aparine*), also known as goosegrass, run-the-hedge, and sticky willie, is the familiar climbing plant of hedgerows, which sometimes becomes a noxious weed in corn crops. The white flowers are small and easily overlooked. The plant reaches the light by growing over other plants, retaining its hold by the numerous squarish branches beset with rough hooked hairs, thus differing from the bindweeds which twine round and round the support. The flowers and leaf arrangement are those of the bedstraw order (Fig 6). Each flower produces one or two fruits, and the whole plant is covered with them in autumn. The fruits are "burs," about $\frac{1}{8}$ -inch diameter, closely covered with

hooks, and thus carried far and wide by animals and man. The wool of sheep may be considerably depreciated by tangled branches and burrs picked up in hedgerows and waste places.



FIG. 6.—*Left*, CLEAVERS, WITH SEEDLING (BOTH SLIGHTLY REDUCED), AND FLOWER (NATURAL SIZE). *Right*, FIELD MADDER (SLIGHTLY REDUCED) AND FLOWER (VIOLET-COLOURED), NATURAL SIZE.

(*Common Weeds*, H. C. Long.)

The rough burrs are common impurities in poorly screened seed-corn, while in grasses and clovers the fruits, rubbed down, with the hooks removed, are not uncommon. Cleaver fruits in seed may be removed by running the seed over a rough cloth, to which the burrs stick.

Wild Carrot (*Daucus carota*), has hooked fruits, not unlike those of cleavers; these are included amongst the list of noxious weeds in samples of grasses, clovers and other seeds, and are frequent impurities either in the rough hooked state or with the hooks rubbed off. Carrot has a strong tap-root, probably the parent form of the cultivated plant, and a rosette of large leaves that are much cut up into small leaflets and lobes. The flowering stems appear either in the first or second year, and bear crowded umbels of small flowers, white with a tendency to purple. In the fruiting stage the outer branchlets curve inwards, so that the whole flower-head has a characteristic "bird-nest" appearance. In Scotland the carrot is not seen as a weed except on the lighter coast soils. It may appear in young grass from seeds present as an impurity. If it occurs in older grassland it is eradicated by spudding before flowering, and winter grazing is also a useful check.

Fool's Parsley (*Aithusa cynapium*), belonging to the same order as carrot, has a reputation of being poisonous, but it is rarely a serious weed, though not an uncommon one. The plant is an annual with a long tap-root, stem fully a foot high, and leaves finely divided like those of the garden parsley when flowering. True parsley has a distinct odour of its own, and yellowish flowers; fool's parsley has white flowers and the bruised leaves have a strong, rather disagreeable odour.

The white flowers of fool's parsley are borne on open umbels, not closed, as in wild carrot. Each flower produces a double fruit, nearly egg-shaped while entire, but when the two fruits are separated in cleaning, one side is flat and the other has five ridges; they are about three times the breadth of true parsley seed, which is sometimes sown in grass mixtures as sheep's parsley. The absence of hooks distinguishes fool's parsley fruits from those of carrot.

Shepherd's Purse (*Capsella bursa-pastoris*) is a common weed on all soils, but not often a pest, except in gardens. The flowers are small and white, with four petals, but the plant is easier to recognise by the broad purse-like fruits (Fig 7). Abundant minute yellow seeds are produced, and at any time of the year



FIG. 7.—SHEPHERD'S PURSE.
(Standard Cyclopadia of Agriculture.)

may give rise to seedlings whose first leaves form a rosette close to the ground. Amongst young grass seeds, these rosettes may occupy the ground to the exclusion of more useful herbage. Flowering and fruiting follow quickly, so that new crops of seeds are soon being dispersed. The plants are shallow-rooted and easily destroyed by surface cultivation, but new seedlings soon appear. This weed belongs to the order Cruciferæ, flowers with four petals, and like most weeds of this order it harbours "finger and toe" fungus, thus infecting the land for crops of turnips and cabbages. Shepherd's Purse often bears the "white rust of Cruciferæ" (*Cystopus candidus*) and another parasitic mildew (*Peronospora parasitica*). The former occurs as deep white crusts on the stems, leaves and flowers, the latter is a greyer, less dense mildew; both of them may be transferred to seedlings of cabbage, wallflowers and other Cruciferæ. The frequency of these parasitic diseases is additional reason why efforts should be made to keep shepherd's purse in check near seed-beds.

THE INFLUENCE OF MAN ON ANIMAL LIFE IN SCOTLAND.¹

A REVIEW.

PROF. J. ARTHUR THOMSON, M.A., LL.D.

FOR many years Dr. Ritchie has been studying, in the scanty leisure of a busy life, the hand of man on the animal life of Scotland. He has utilised a vast quantity of old records, not only in print, but embedded in peat mosses and the floors of caves, and he has done this so thoroughly and so judiciously that it will never need to be done again. Leaves may be added to his book, perhaps, but it will remain the authority on the subject. It is a big contribution to the Natural History of Scotland, and no one can read it without gaining a new interest in the country, for the state of affairs to-day is shown to be the outcome of slow and subtle changes in the faunistic capital with which Neolithic man started when he penetrated into Scotland some ten thousand years ago. The book is outstanding in its careful scholarship, in its biological insight combined with historical sense, and in its clear, dignified style which often reminds one of Darwin's at his best. In its extraordinarily acute realisation of the interlinking of organisms and of the multiple consequences of apparently trivial moves in the game, the whole spirit of the book is Darwinian. It is well and wisely illustrated, Dr. Ritchie's own drawings reaching a high level of artistic skill. We congratulate the author on his fine achievement. It is in the line of succession of Marsh's well-known "Man and Nature" (1864), or, as its second edition (1874) was called, "The Earth as Modified by Human Action," a great book in its day; and it also recalls a remarkable address delivered in

¹ "The Influence of Man on Animal Life in Scotland: a Study in Faunal Evolution," by James Ritchie, M.A., D.Sc., F.R.S.E., Assistant-Keeper in the Natural History Department of the Royal Scottish Museum (Cambridge University Press, 1920, pp. xvi. + 550, 90 figs., 8 maps. Price 28s. net).

1879 by Prof. George Rolleston on "The Modifications of the External Aspects of Organic Nature produced by Man's Interference" (see vol. ii. of his "Scientific Papers and Addresses").

Dr. Ritchie has been successful beyond others who have worked at the subject, partly because of his persistent patience, and partly because of his personal blend of scientific temper and historical sense, but also because of his restraint. He has kept to animal life and to the animal life of Scotland. The advantage of keeping to Scotland, which has given the book a remarkable unity and convincingness, is threefold. In the first place the Great Ice Age made a clean sweep of the original Scottish fauna, so that one starts in the inquiry, as Neolithic man did in practice, with the post-glacial immigrants from the south of England and from what we now call the Continent. With that faunistic capital, including such large herbivores as elk, reindeer and wild cattle, such carnivores as lynx, brown bear and wolf, and such interesting birds as bittern, crane and great bustard, Neolithic man—"long-headed, square-jawed, short but agile-limbed hunter and fisherman"—started, into it his successors sometimes dipped heavily, and to it he and they made, from time to time, notable additions. But the insulation of Britain has meant, of course, that very few immigrants of considerable dimensions could be introduced except by man, or unless, like birds, they came by air. In the second place, Scotland is a small, compact country, allowing of accurate survey, and without any great heterogeneity in its increasing environmental sifting. In the third place, within recent times, Scotland has been the home of a succession of honest observers and recorders, into whose labours Dr. Ritchie has entered.

In his preface Dr. Ritchie makes a useful distinction between (a) the temporary and local changes in a fauna, the ebbing and flowing of vital tides, the disturbance and readjustment of numerical proportions, and (b) the great secular changes which produce permanent changes, bringing about what might be called drifts. "Now, part of Man's influence, where it is inconstant in tendency, is of no more import in the long run than the internal tides of the fauna, but it is strikingly true that the greater part of his influence ranks with the great secular changes. For his interference tends to persist in fixed directions, and so impels individuals in the fauna and the fauna as a whole upon a definite path along which there is no return. So sweeping are the changes wrought by Man and so swift are they in their action that they obscure and almost submerge the slow march of the other processes of nature." The book is an answer to the question: What changes has man wrought, both deliberately and without intention, both directly and indirectly, on the animal life of Scotland?

The first deliberate change was involved in the domestication or continued domestication of wild animals, a process of which we know little, but which had not only direct transforming effects on the structures and functions, habits and temperaments of the animals immediately concerned, but direct transforming effects on the vegetation and small fauna of the country. Pastures had to be extended and the safety of the flocks and herds had to be secured. Those concerned with farm animals will enjoy the

chapters dealing with the history of sheep, cattle and horses in Scotland, not to speak of lesser animals like dog and pig, fowls and pigeons, and the Grey Lag goose. This subject of domesticated stock is a very difficult one; Dr. Ritchie has handled it with shrewdness and caution.

The second deliberate interference was the destruction of wild animals. This began with securing food and keeping firm foothold (the elk is hunted down and the wolf is trapped, till there is none of them); it extended to an elimination or reduction of the racial enemies of domesticated animals (the lynx and the bear disappear, the wild cat and the sea-eagle become rarities); it swept into its clutches the smaller fur-bearing mammals (such as polecat and pine-marten, which are rapidly approaching extermination); and so a rather saddening story continues. We cannot object, we suppose, to securing food, even when it means the extinction of the great auk; we cannot object, we suppose, to a reasonable amount of safety, even when it means the passing of the wild boar; but what pulls us up is the destruction of interesting and beautiful creatures, from osprey to water-ouzel, for the sake of—"fun." And it happens so often that a destruction deplorable scientifically and æsthetically is also to be regretted on economic grounds, for the killing off of carnivores almost inevitably means the multiplication of rodents. But we are reminded that Dr. Ritchie writes very temperately on this subject.

The third deliberate interference is the protection of animal life, sometimes superstitiously (when robin and wren, spider and ladybird, are left in peace), sometimes by popular goodwill (when cuckoo and nightingale and many another bird is held as sacred), but usually by "the law." The story is well told, how laws were originally in the interest of sport; how they broadened out to include economically useful animals, from fishes to farmers' friends; and how they have of late begun to extend their protection to creatures whose only merit is the supreme one of being exquisitely beautiful.

The fourth deliberate interference is the introduction of new animals, sometimes for utility as in the case of rabbits, sometimes for the sake of sport as in the case of pheasant and capercaillie, and sometimes for amenity as in the case of the peacock. Nothing has happened in Scotland so drastic as what followed the introduction of rabbits into Australia or sparrows into the States, but Dr. Ritchie sounds the warning note. For the Balance of Nature is subtle, and though it always readjusts itself, much is apt to be lost by the way. One is sometimes tempted to think that man might do more, after careful consultation with scientific experts, in the way of introducing novelties, especially of a controllable size—*e.g.* peacocks. But perhaps there is deeper wisdom in making the most of what is more or less native to the soil, especially as we are not sure that even the college of scientific experts would have foreseen that the introduction of European trout into Tasmanian rivers would prejudice the interests of the fruit farmer.

Dr. Ritchie's book is so thoroughly interpenetrated with the Darwinian idea of the correlation of organisms in the web of life

that it is with no surprise that we come to a large section devoted to man's indirect interferences. There is a very able discussion of the causes leading to the destruction of the forest and of the manifold consequences that followed. It must be borne in mind that the Scottish fauna was originally a forest fauna. The extension of cultivated fields on the one hand and the growth of towns on the other must also be reckoned with as productive of manifold effects. The reclamation of marshland meant the disappearance of bittern and crane; the extension of arable ground meant a multiplication of vegetarian animals; novel corners of life, such as water-works and coal-pits, are seized and colonised by insurgent creatures. Dr. Ritchie is very felicitous in dealing with "the camp-followers of commerce," "undesirable aliens" such as new parasites, "stowaways on ships" such as rats, "skulkers in dry food materials" such as grain weevils, "foundlings among fruit" such as cockroaches, and "timber transportees" such as giant saw-flies.

It comes to this, then, that man has transformed, eliminated and introduced, and what is the net result? It cannot be said, as is sometimes hastily supposed, that either the numerical strength or the variety of the Scottish fauna has been reduced. Some fourteen different species of birds and beasts have disappeared, and various insects have likewise passed, but far more have been introduced. "The wild fauna has not fallen off in numbers nor in variety, but visible numbers and varieties have gone, and their places have been taken by invisible hordes; the smaller things have been added in a bigger ratio than the larger have been lost. The standard of the wild fauna as regards size has fallen and is falling." And it is not merely in size but in interest that the new-comers are inferior to those that have gone. "In spite of statistics and of multitudes of species, we have in effect lost more than we have gained, for how can the increase of Rabbits and Sparrows and Earthworms and Caterpillars, and the addition of millions of Rats and Cockroaches and Crickets and Bugs ever take the place of these fine creatures round the memories of which the glamour of Scotland's past still plays—the Reindeer and the Elk, the Wolf, the Brown Bear, the Lynx, and the Beaver, the Bustard, the Crane, the bumbling Bittern, and many another, lost or disappearing."

No one interested in any of the many sides of agriculture should miss this book, which is as entertaining as a novel and as illuminating as a poem. It is a book which will live.

THE CLYDESDALE HORSE.

ARCHIBALD MACNEILAGE,

Editor of "The Scottish Farmer" and Secretary of The Clydesdale Horse Society.

HAVING been identified with the Clydesdale Horse Society of the United Kingdom of Great Britain and Ireland since May 1878—that is, within a year of its institution, which took place on 30th June

1877—and having been the author of the larger proportion of writings dealing with Clydesdale horses since about the year 1880, the writer cannot profess in this article to introduce any new material or to advance any novel theories. The Clydesdale breed, in his view, was known as a distinct race of draught horses from the closing decade of the eighteenth century, and its history and origin must be looked for in the part of Scotland to which it owes its name. Clydesdale is the ancient name for Lanarkshire, just as Tweeddale is the ancient name for Peebles, and Teviotdale for Roxburgh. The credit, therefore, of founding the Clydesdale breed, which is really the Scottish breed of draught horses, must be ascribed to those engaged in the prosecution of agriculture in the valley of the Clyde.

Historical.—The history of the breed may conveniently be divided into four sections: first, the traditional, ending with the Revolution Settlement; second, the historical, particulars of which may be found in the Old Statistical Account completed in 1820; third, the modern, covering the period of the nineteenth century up to the foundation of the *Stud Book* in 1877 or its production in 1878; and fourth, the systematic, carried on under the guidance of the *Stud Book* from that date.

Horse-breeding engaged the attention of Scottish kings from an early date. There was a trade in horses between Scotland and the continent of Europe as early at least as the fifteenth century. The Douglasses, who were the ancestors of the Hamilton ducal line, played an important part in that trade. The horses bred were capable of bearing heavy armour, and in those far-off days when war seemed to be the chief occupation of nations this armour-bearing horse was in keen demand. Scotland had little rest during the turbulent Stuart period, and it was not until the Revolution Settlement in 1690 gave the land rest from war that men devoted themselves with zest to the arts of peace. The development of the Lanarkshire coal-fields undoubtedly led to strong efforts being made to improve the native breed of horses in respect of weight and haulage power. Previously horses were bred rather for carrying than for draught. A sure-footed nag capable of carrying a good load along a bridle path was more likely to have been in demand than a heavier animal which pulled by the shoulder. The formation of roads and the development of agriculture alike called for a heavier horse, and tradition points to the additional weight having been secured by the use of Flemish stallions introduced, according to one story, by James, the 6th Duke of Hamilton (1742-1758), and according to another, by John Paterson of Lochlyoch, in the parish of Carmichael, Lanarkshire, about the year 1715-1720. With these data the historical period began.

To Sir John Sinclair, Bart., the world is indebted for the Old Statistical Account of Scotland. The reports embodied in that account were generally written by the parish ministers. They constitute a rich mine of information regarding agriculture and the industries of Scotland generally during the eighteenth century. Several of the writers refer to the importation of

Flemish stallions characterised as six black stallions from Flanders which were kept by the Duke of Hamilton of his time—about the middle of the seventeenth century—at Strathaven Castle. The late Lawrence Drew, who was tenant of the farm of Merryton, Hamilton, and died in March 1884, was twenty years earlier factor on the Duke of Hamilton's estates in Lanarkshire. He had excellent opportunities for obtaining access to the historical records. He was not disposed to accept the tradition of the six black stallions from Flanders, but he regarded it as an historical fact that the 6th Duke of Hamilton imported one Flemish stallion, dark brown in colour, which he kept for the use of his tenantry. This and John Paterson's Flemish stallion, therefore, may be accepted as having been agents in increasing the size and weight, for draught purposes, of the native breed of horses in Clydesdale.

The climate and soil of the Avon and Clyde valleys are admirably adapted for stock-breeding and stock-rearing, and Lanarkshire enjoyed a high reputation for its horses from a very early period. The fairs held at Biggar and Lanark were frequented by dealers from England, and it is an historical fact that annually large mobs of yearling colts and fillies were drafted from these fairs into English markets.

The modern history of Clydesdale breeding may be said to date from the first decade of the nineteenth century. To a large extent it was due to the formation of the Highland Society in 1784. The first general show of that society was not held until 1826, but as early as 1816 premiums were offered by it for improving the breed of horses in Kintyre and Easter Ross. At its first general show, held at Glasgow on 27th September 1826, prizes were offered for Clydesdale mares and fillies in the counties of Renfrew, Lanark, Stirling, Dumbarton and Ayr. Thus early was the breed recognised by the name which it bears to-day. Travelling cards began to be issued for horses, and premiums were offered as early as 1831 for Clydesdale stallions to travel in the Stewartry. The winner in 1831 or 1832, and again in 1833 or 1834, was Samson 1288, and in the intervening year a horse named Clyde was hired from Mr. James Frame, Broomfield, Dalserf.

In the introductory history to the *Clydesdale Stud Book* the great stream of Clydesdale breeding is traced to the Lampits mare which was bought at the dispenishing sale at Shotts Hill Mill in 1808. She was descended from the Lochlyoch breed of John Paterson, already referred to. The one difficulty the writer has in accepting that theory is that it seems to make the creation of a breed of world-wide fame too simple a matter. A comparison of dates is also fatal to acceptance of the story in its simple details as set forth in the said introductory history. The Lampits mare is said to have been the dam of Glancer 335, and his foaling date is given as about 1810. But Glancer 335, locally known as Thompson's black horse, was the sire of Paton's horse of Bankhead, which won second prize at the Highland Society Show in Edinburgh in 1842. Paton's horse was six years old at that time and consequently he must have been begotten in 1835. If so, Glancer 335 would then have been about twenty-five years old when he served the dam of Paton's horse. That is certainly not

impossible, but on the face of it one rather suspects that there is a hiatus somewhere and probably one or two generations dropped. It is, however, quite certain that Glancer 335 was of the same line as the Lochlyoch breed. His most influential descendant was Broomfield Champion 95, and again with respect to his age one is disposed to fear that there is some slight mistake. In June 1892 Mr. Archibald Bulloch, Milliken, New Kilpatrick, Dumbartonshire, was still alive. In his time he had owned two colts whose sire was Broomfield Champion 95. One of these colts was Young Champion 937, and he was foaled about 1843, when Mr Bulloch was tenant of the farm of Brainzet, in the parish of Baldernock. The other colt of the two was the horse registered as Glancer 338 and also as Superior 836 (these are duplicate entries of the one horse). Broomfield Champion was an extremely impressive sire; he lived to a good age and travelled in Aberdeenshire, where he was known as Aberdeen Champion. His influence in the male line is carried through Bowman's colt 1078, foaled in 1841, and Clyde *alias* Glancer 153, popularly known as Fulton's ruptured horse. The dam of Clyde *alias* Glancer 153 was a Clydesdale mare—that is, a real Lanarkshire mare—and he proved himself to be a remarkably impressive sire. There are seven stallions registered as his sons in the Retrospective volume of the *Clydesdale Stud Book*, and without exception each of these seven left his mark on Clydesdale history. They varied in respect of their distinction in the show-yard, but it would be difficult to name any seven horses all got by the same sire whose influence in moulding a type has been greater. With Clyde *alias* Glancer 153 the centre of Clydesdale breeding passed from Lanarkshire to Renfrewshire, and gradually it became dispersed throughout the whole of Scotland.

The Galloway Clydesdales.—From a comparatively early date the district of Galloway, embracing the counties of Wigtown and Kirkcudbright and South Ayrshire, enjoyed a high reputation for a breed of native horses. Sir Walter Scott in *The Fair Maid of Perth* (chap. viii.) represents the gallant smith as riding “on a strong black horse of the old Galloway breed.” The Rev. Samuel Smith, parish minister of Borgue, who published a survey on the early agriculture of Galloway in 1810, is eloquent in his praises of the old Galloway nag. He speaks of it being modified by the desire of farmers to breed horses of greater weight and better adapted for draught. This increase in weight and draught power Mr. Smith traces to the introduction of well-boned stallions from England and Ayrshire and to a less extent from Ireland. The improved product thus described by the reverend chronicler are said to have been from 14 to 16 hands high and at four years old they were sold at prices varying from £15 to £50. On this foundation was built in the second quarter of the nineteenth century through the introduction of Clydesdale stallions and mares from Lanarkshire one of the most influential tribes in the Clydesdale world. About the year 1840 a member of the family Muir went from Sornfallo, on the slopes of Tinto, to the Banks Farm, Kirkcudbright, and about the same time another member of the same family entered

on the occupancy of the farm of Maidland, Wigtown. These gentlemen took with them their Lanarkshire horses, but even earlier than this, as we have indicated, Samson 1288, which was owned by Mr. John Muir, Sornfallo, was hired by farmers to travel in the Stewartry. Col. M'Douall of Logan, Ardwell, was an enthusiastic supporter of the Clydesdale breed. In 1830 Farmer 292, known locally as the Balscalloch horse, won a £30 premium at the Dumfries show of the Highland and Agricultural Society. There was keen rivalry between the laird of Logan and Mr. Robert Anderson, who in the early part of the second quarter of the nineteenth century was tenant of the farm of Drumore, Ardwell. In 1835 Mr. Anderson made an historical excursion into Lanarkshire and Renfrewshire and purchased a celebrated black mare named Old Tibby, and another mare as well as the stallion Old Farmer 576. Mating these with the native stock, Mr. Anderson practically introduced a new breed into Wigtownshire. The climate and soil of Galloway are peculiarly favourable for the breeding and rearing of draught horses. Different writers in the early part of the nineteenth century speak approvingly of the merits of draught horses bred in Galloway. A pair of them, we are told, cost £64, 15s. The Scottish farm horse is characterised as preferable to any to be seen in England. They were of greater weight than blood-horses and better adapted for draught. Consequently when this native breed was mated with the Clydesdale from Lanarkshire a type was evolved which in a peculiar degree came to be recognised as the genuine Clydesdale breed.

Ayrshire and Kintyre.—Both the county of Ayr and the district of Kintyre, in Argyllshire, contributed greatly to the formation of the modern Clydesdale. A notable tribe of horses is descended from a mare named Bell owned by the late John Scott, Barr Farm, Largs, Ayrshire. In 1849 she produced Old Clyde 574, the first horse owned by the late Mr. David Riddell, Blackhall, Paisley, who for more than half-a-century occupied a very prominent place amongst owners of Clydesdale horses. From this race in direct male line came the Merryton Prince of Wales 673. Kintyre Clydesdales have a distinct Lanarkshire origin. In the early part of the nineteenth century the estates of Lec in Lanarkshire and of Largie in Kintyre were in one ownership, and it is a matter of history that Clydesdales were transported from the one estate to the other. Three stallions contributed greatly to the moulding of the modern Kintyre Clydesdale. Two of these were Farmer's Fancy 298, a son of the ruptured horse Clyde *alias* Glancer 153, and Rob Roy 714, foaled somewhere about 1845, and, like one of Sir Walter Scott's characters in *Guy Mannering*, of somewhat hazy pedigree, but certainly, alike in respect of his sire and his dam, of the genuine Lanarkshire breed. Although rather hollow in the back, Rob Roy had faultless feet and legs and great depth and weight. He was an extremely popular sire and alike in Kintyre and in Galloway, where he subsequently travelled, he bred first-class stock. It is just possible, however, that several of the progeny with which he has been credited in Kintyre were got by his son, Rob Roy 2379.

The third historical sire in Kintyre was Largs Jock 444. He belonged to the Ayrshire tribe already referred to, and his produce were characterised by great substance. The record of having won first at the Highland and Agricultural Society Show three years in succession was for a long time held by Prince of Kilbride 660, one of his sons. During the sixties and early in the seventies of last century mares by Largs Jock were in great favour. They were prominent in the show-yards and popular with breeders. Both Rob Roy and Largs Jock were faultless in the formation of their feet and pasterns. Unfortunately Farmer's Fancy 298, which ante-dated them in the Peninsula, had somewhat narrow feet. A good many years later Lorne 499 travelled in the Peninsula for many years. He left stock with splendid bodies, but they too were rather cramped in the formation of their feet. This in some degree was a hindrance to the sustained popularity of the Kintyre Clydesdales. In respect of substance and general Clydesdale character they were difficult to beat.

Cumberland and Aberdeenshire.—In the early days of draught-horse breeding the north of England and the north of Scotland laid the foundations of a reputation for producing the best class of heavy street work horses. Whether this may have been in some measure due to the somewhat mixed foundation on which the draught-horse tribes of these areas were based is a matter for conjecture. There can be no doubt whatever as to the genuinely Clydesdale character of the horses of Cumberland and Westmorland. Clydesdale horses such as Old Bay Wallace 572, bred in Ayrshire and foaled as early as 1827, travelled in Cumberland up to 1838. Old Stitcher 577, foaled previous to 1815, was bred by Major Millar of Dalswinton, Dumfries, and was owned successively by Mr. Muir, Sornfallo, and Sir James Graham, Bart., Netherby. He went to Netherby in 1815 and had gained a £40 premium at Linlithgow before that. His grandson, Young Clyde 949, bred near to Hyndford Bridge, in Lanarkshire, in 1826, travelled for many years in Cumberland. He was a horse of good size and strength and was held in great repute in the north of England. A very notable Cumberland horse was Phillip's Merry Tom 532. He was foaled in 1848 and, like many other of the best horses that came from Cumberland, he was grey in colour and won first prize alike at the Glasgow, Highland and Agricultural Society, and the Royal Agricultural Society of England shows. He was the premium horse for the Glasgow district in 1852, and we have heard him described by the older men who have passed away as the best-looking and the worst-breeding stallion that ever won the Glasgow prize. Doubtless prejudice had a good deal to do with this verdict. Merry Tom was descended on both sides from Old Stitcher. There is every reason to believe that Maggie *alias* Darling, a handsome mare which won first prize as a brood mare at the Highland and Agricultural Society's Show in Glasgow in 1857, was got by him. She came out of Cumberland and became dam of General 322, in his turn sire of the Merryton Prince of Wales 673.

Lorne 499, already referred to in connection with Kintyre, was descended from the Cumberland line of Clydesdales.

Aberdeenshire Clydesdale breeding prior to the year 1883 proceeded along distinctly different lines from those consistently followed by breeders in Aberdeenshire since that date. During the period now under review quite a number of horses that came from England travelled in Aberdeenshire along with a large number of high-class, powerful stallions from Lanarkshire and the south of Scotland generally. In 1823 a horse named Young Glancer, owned by Mr. Thompson, Glasgow, and believed to have been a son of Glancer 335, travelled in Aberdeenshire. He was first at Hamilton as a three-year-old. Young Champion of Clyde, foaled in 1840 and a prize-winner in the west of Scotland, travelled in the county from 1846-1854. Farmer's Fancy, a dark brown horse foaled in 1847, travelled for some years after 1851. Justice 420, under the name of Emperor, was travelled for some years by the late Mr. Peter M'Robbie. The two greatest sires, however, in this earlier period of Clydesdale breeding in Aberdeenshire were Grey Comet 192 and Lord Haddo 486. These were horses of quite outstanding merit; the former was foaled in 1849, was first at the Highland and Agricultural Society Show at Inverness in 1856, and was destroyed at Dalkeith in 1866. Lord Haddo was foaled in 1853 and gained second prize at the Highland and Agricultural Society Show in Aberdeen in 1858. He died in 1874 or 1875. On the sire's side he belonged to the Ayrshire race of Old Clyde 574. A notable sire in Aberdeen was Eclipse 268; he left an enduring influence on the breed through his daughter Jean, which became the property of Mr. Alex. Wilson, Middleton, Newton Mearns, and bred a succession of high-class colts and fillies, the best known of which was What Care I 912.

Famous Studs.—During this period (1840-1877) landed proprietors and wealthy coal-masters in different parts of Scotland devoted their attention to the breeding of Clydesdales. Their names frequently appeared in the prize-lists of the Highland and Agricultural Society. Competition between them was unusually keen, and this came to a head at the first International Show held by the Royal Agricultural Society of England at Battersea in 1862. The Highland and Agricultural Society held no show in that year, consequently the efforts of the breeders were concentrated on securing success at Battersea. Prominent amongst these wealthy breeders were Mr. Buttery of the Calderbank Ironworks, Old Monkland; Mr. John Watson, Glencairn, Hamilton (afterwards Sir John Watson, Bart.); Sir William Stirling Maxwell, Bart., Keir, Dunblane; Mr. Wellwood Maxwell of Glenlee, New Galloway, and, perhaps during a shorter period, the Duke of Hamilton. The three studs owned by the three last-named were managed for their respective owners by Mr. Alexander Young, Keir Mains; Mr. Oliphant Brown, afterwards of Shield New Galloway; and Mr. Lawrence Drew, whose name has already been mentioned. These three gentlemen as representing their respective superiors were constantly on the outlook for first-class fillies, and the rivalry between them at the principal shows

conducted greatly to the advancement of the interests of the breed, as well as to its improvement. Tenant farmers also greatly distinguished themselves during this period as breeders of stallions and mares which have become historical. It would be invidious to select the names of any of these gentlemen, as no selection could possibly be exhaustive. The Keir Stud was continued with an unbroken history until about the year 1890. The Glenlee Stud ceased to exist as such during the sixties and Mr. Brown began to farm on his own account. The Merryton Stud was taken over by Mr. Drew personally, who began to farm on his own account at Merryton during the early sixties and continued to do so until his death in March 1884. Perhaps of all these studs the most fruitful in respect of its enduring influence on the breed were those at Keir and Merryton. On the foundation thus laid was built that systematic course of Clydesdale breeding which came into vogue with the publication of the *Stud Book* in 1878.

Systematic Breeding.—Three causes operated during the latter part of the nineteenth century to bring about a distinct change in the popular type of Clydesdale horse. These three causes have been the show-yards, the Scottish system of hiring stallions, and the *Stud Book*. Prior to the institution of the last-named the best record of pedigrees was to be found in the catalogues of the shows of the Highland and Agricultural Society and the Glasgow Stallion Show. When pedigrees first began to be published in this way can be gleaned by an examination of files of these catalogues. The process was gradual, but the system was general, in so far as Clydesdales were concerned, during the sixties of last century. In the nature of the case there was a good deal of hearsay with respect to some of these pedigrees, but on the whole, having regard to the absence of any public control, they proved to be a fairly accurate guide in the compilation of the Retrospective volume of the *Clydesdale Stud Book*. Generally they were found to be much more reliable than the cards issued regarding stallions travelling for service. Many of these contained very useful information, but as a rule in compiling the Retrospective volume it was found necessary to scrutinise their statements with some care and wherever possible to verify them by correspondence with the oldest men then alive amongst breeders. Still, no matter how accurate statements in catalogues might be, they never gave information beyond the sire of the dam of any particular animal, and very often the pedigree ended with a simple statement of the name of the sire. Pedigree registration on a systematic form recording the generations back as far as they could be traced constituted a much surer guide, and its increasing influence is to be traced in the growing uniformity of type.

The Hiring System.—Reference has already been made to the early date at which the Scottish system of hiring came into vogue. Up till about the year 1873 many districts held shows of their own at a central market town. These might attract a gathering of perhaps a dozen stallions, and from this number the judges

appointed selected a premium horse for the immediate area. The early premiums seldom went beyond £50, and the service money was commonly not more than £1 at service and £2 additional for a foal, with 2s. 6d. in the case of each service to the groom. Such a method of hiring horses was obviously wasteful and did not conduce to a satisfactory selection. The Glasgow Agricultural Society had held a show of the kind indicated in the Glasgow Cattle Market at least from about 1840. The Society celebrated the Diamond Jubilee of its Stallion Show in 1920, and if the dates be correct this would mean that the show was inaugurated on something like its present basis in the year 1860. My own opinion is that this is a mistake. I am confident that the Glasgow Stallion Show was in existence at least twenty years earlier, although proper records of the show may not be in existence further back than 1860. Inadequate as the method was, the Scottish hiring system undoubtedly contributed in no small degree to the effective distribution of first-class sires, according to the standards then prevalent, throughout the chief breeding areas in Scotland. About the year 1870 a movement took shape having as its aim the extinction of all the local societies and concentration of effort on one first-class show of Clydesdale stallions to be held in the Glasgow cattle market. The proposal met with hearty support from all the district societies. These agreed to abandon their shows in favour of the one general show in Glasgow and in return the Glasgow Agricultural Society granted free admission to the deputations from the local societies and reserved for them a special inspecting ring where they had a very fair view of all the stallions exhibited alike in the aged class and in the class for three-year-olds. Hiring was carried on busily during the afternoon preceding the show as the horses began to arrive. Contracts made that day were, however, subject to cancellation should the judges on behalf of the Glasgow Society hire the horse on the following day. This was the only advantage the directors of the Glasgow Society claimed. In other words, it amounted to a first choice for the Glasgow district of all horses exhibited. Hence up to the institution of the Cawdor Cup in 1892 the highest honour for a stallion in the Clydesdale world was the Glasgow prize. The arrangement worked very well so long as all hiring was postponed until the show at Glasgow, which usually took place on the third Tuesday in February. However, in 1882, on the afternoon of the day preceding the show, the deputation of the Central Aberdeenshire Society hired Lord Erskine 1744, then rising three years old, subject to the proviso already named. On the following day the judges acting on behalf of the Glasgow Society awarded Lord Erskine their premium. This cancelled the engagement by the Aberdeen gentlemen and they fell back upon their second choice, which was Strathleven 1539. Having formed a very high opinion of Lord Erskine 1744, the Aberdeen deputation resolved not to be balked a second time and in October 1882 they hired Lord Erskine for the season of 1883, on the distinct understanding that he was not to be exhibited at the Glasgow show. From this date the hiring of stallions well in advance of the Spring Stallion Show at Glasgow became increasingly popular,

until in the year 1890, in order to have a good show, open classes were instituted at the Glasgow Stallion Show for horses irrespective of any restriction as to hiring. As an indication of the extent to which stallion hiring on this advanced basis goes on, it may be mentioned that prior to the Stallion Show held this year on 6th March 180 stallions had been hired for 1920, 76 had been hired for 1921, 10 for 1922 and 3 for 1923.

Standard of Judging.—The standard of judging in Scottish show-yards has undergone a remarkable evolution during the past fifty years. An examination of photographs of representative Clydesdale stallions and mares beginning with Prince of Wales 673, which was foaled in 1866, and finishing with the champion horse of 1920 reveals the slow but steady evolution of a draught horse excelling in the wearing qualities of feet and limbs, with a general refinement of type, and increasing evidence of the intangible but easily recognised quality known under the general term of "breeding." In the ordinary language heard round a ring-side the Clydesdale of 1920 shows an amount of breeding hardly to be recognised in his ancestor, and the influences which have gone to mould opinion in favour of this refined type are rather difficult to analyse. It would certainly be impossible to dogmatise concerning it; but the contrast could scarcely be greater between a horse of the type of Drumflower Farmer 286 and Topsman 886, both of them foaled in 1869, and that represented in the classical horses of 1920. The two older horses named are unfortunately only known to the present generation by paintings, or photographs from paintings, the originals of which could scarcely be regarded as works of art. However, some of us remember these horses very distinctly, and it may be well to put on record an impression of their type as compared with the fashionable show horse of to-day. Farmer 286 and Topsman 886 had both, in comparison with present ideals, very short legs. They had great depth of rib. Topsman had a magnificent back and very well sprung ribs; he stood well up at the shoulder, with fine withers; his head was strongly suggestive of something of the Shire and there is a long-standing dispute that will never be settled now as to the breeding of his dam. Farmer 286 had the same great depth of rib; his back, however, was longer and rather "easy"; he had great big quarters, but he was not nearly so well set up at the withers as Topsman. One seldom sees a horse in show-yards now exactly of the type of these two horses. Both made their mark in the show-yard. Topsman was the Highland and Agricultural Society first prize winner at Stirling in 1873 when four years old. Farmer did not get so high up in the show-yard, but as a sire he produced three stallions, all of which won first prize at Glasgow when three-year-olds, and two of them also secured the highest honours at the Highland and Agricultural Society show. These three stallions were Disraeli 234, Sir Colin 777, and Druid 1120. The last-named represented the short-legged, deep-ribbed type in its most extreme form. None of these horses would have passed muster in respect of quality of limbs with the judges of to-day. The bones of Farmer 286 were flat, sharp and clean, but his son Druid had rather round bones,



HIAWATHA 10,067

1802 1015.

Winner of Crawford Cup in 1901.

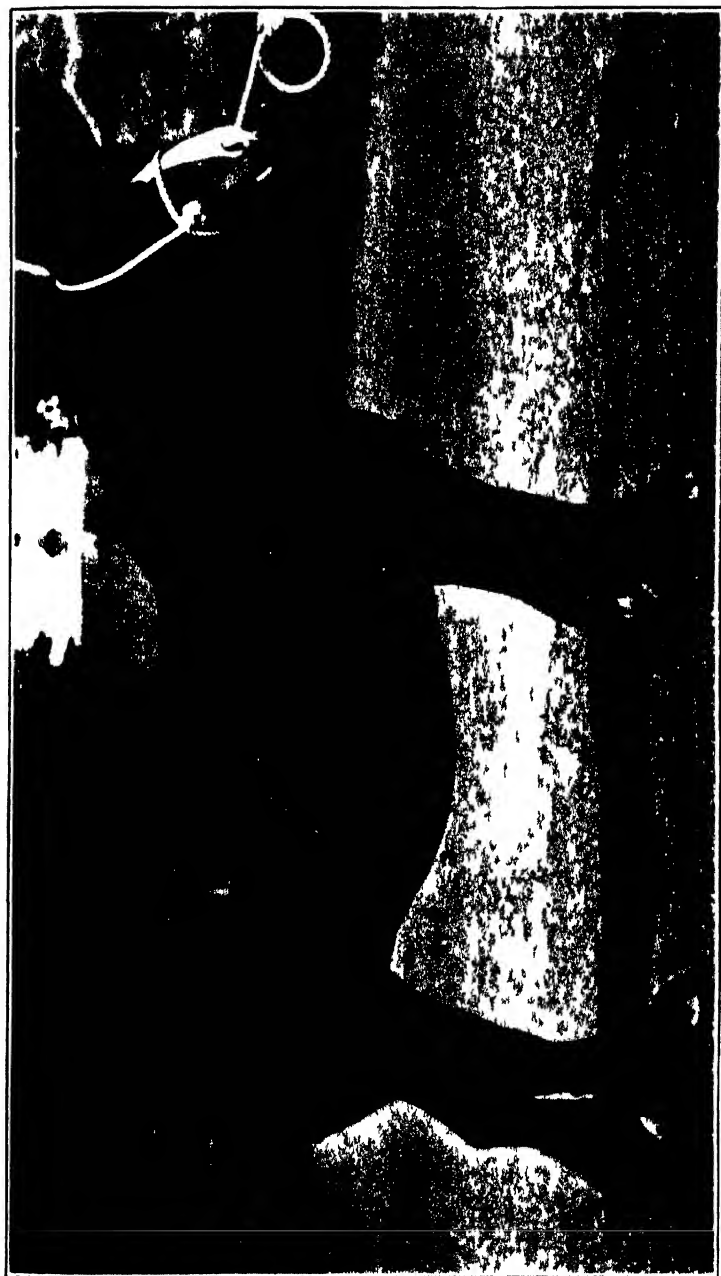
By bird pen in of the Clyde d. H. C. Society.



ROSALIND 45,029

Bred 1913 - Cawdon Cup Winner in 1916

By the original Chd. of the Sire



MO S RO-I 6203

ISSI 1005

W i f C w l i i (u i m 1894 m l 1855

I I f (l l e H n



15,253 IN 1911 100TH IN 1911

1911 100th In 1911 100th In 1911 100th In 1911 100th In 1911

1911 100th In 1911 100th In 1911 100th In 1911 100th In 1911

and he did not carry the same silky, "leashy" fringe of hair. Excellent as these horses were from a draught point of view, and useful as they proved in a general way at the stud, their names occupy a subordinate place in the pedigrees of fashionable Clydesdales.

The Modern Type.—The modern type of Clydesdale has been evolved rather through the lines of Prince of Wales 673 and Darnley 222. The latter was undoubtedly the most influential sire the breed had produced up till his own time, and perhaps at this stage it will conduce to a clearer indication of the modern development under systematic breeding rules if a few particulars be given regarding the most influential sires.

Impressive Sires.—The Clydesdale bred about midway in the nineteenth century was an animal of great substance, big size, with stout limbs, deep ribs, not infrequently a somewhat lengthy back, and generally big quarters. Paintings of that period need not be taken as too faithful representations of the animals whose name they bear, but they do convey a quite accurate idea of the type of animal that was favoured. Lochend Champion 448 was foaled in 1856. His characteristics are sufficiently emphasised by his popular title, "Kerr's Big Horse." He was first at the Highland and Agricultural Society Show in Perth in 1861, and second at Battersea in 1862. One of his sons was Logan's Lord Derby 484 and he in turn became sire of the Lochburnie Crown Prince 207 (1869-1880). The painting of this horse gives a good idea of the type farmers were eager to breed. He had a first-rate formation of head, and stood on very stout, short legs with good quality of bone; his back or barrel was unduly long and he showed symptoms of some slackness on the top line. He was twice a second prize winner at the Highland and Agricultural Society Show, and once first at the Glasgow show. He acquired fame as a sire, his two daughters, Damsel and Diana Vernon, bred by Mr. John Martin, Auchendennan, Dumbarton, were notable show winners; the former was almost never beaten, and was sold by public auction for exportation to New Zealand in August 1879 for 500 guineas. She and her full sister both went to the antipodes. Another favourite sire of the same period was General Williams 326, foaled in 1853, and second at the Highland and Agricultural Society Show in Perth in 1861. This was a popular sire which travelled long in the Rhins of Galloway, where he was locally known as "the bully." A son of his named Sir William Wallace 803 travelled in Islay and Kintyre and left excellent stock.

Reference has already been made to the Drumore Clydesdales in Galloway. Drumore Tibby, one of the mares owned by Mr. Robert Anderson, produced four great stallions: Prince Charlie, which was exported early to Australia; Victor 892; Salmon's Champion 737, and Merry Tom 536. She was a notable prize-winner; her dam, Drumflower Susie (1836-1859), bred nineteen foals and twice gave birth to twins. The three horses bred from Drumore Tibby all made Clydesdale history. Prince Charlie,

Victor and Salmon's Champion were full brothers, and their sire, Farmer 284 (foaled in 1853) was conspicuously successful, although he was suspected of being affected with stringhalt. Nothing further can be said about Prince Charlie than that he was first at the Highland and Agricultural Society Show at Glasgow in 1857 when two years old, and was there sold for exportation. Victor was a magnificent horse, foaled in 1858, and second at the Highland and Agricultural Society Show at Stirling in 1864. The older generation, who have all passed away, were exuberant in their praises of Victor. He was a horse of great substance, what is usually indicated by the term "a grand horse," and during the four years that he travelled in Galloway before being exported he left a large proportion of the finest mares ever seen in any district. One of the last of the race was Barlae Doll 344 (1862-1889). She produced twelve foals. In respect of her fruitfulness and long life she was typical of the race. Salmon's Champion was also a wonderfully fine horse, but did not travel in this country to the same extent as Victor. He became sire of one of the most celebrated horses the breed ever produced, Lochfergus Champion 449 (1861-1877). This was a horse of great substance and size, with strength of bone. He was full of masculine character, and for many a day his female produce were in great repute. His name occurs more frequently in the index of the Retrospective volume of the *Clydesdale Stud Book* than that of any other historical sire except Barr's Prince Royal 647. His female produce were much more celebrated than his sons, and yet so far as unbroken continuity of history is concerned it is to one of these sons, Conqueror 199, that he owes his undying fame. This Conqueror, a somewhat undersized, short-legged, thick horse, was the Dunblane, Doune and Callendar premium horse in 1871, where he became sire of the world-famed Darnley 222. Merry Tom 536 travelled for many years in Galloway, where he was extremely popular. He was a fine horse, rather easy in his back, and became sire of Drumflower Farmer 286 already referred to. The dam of the said Farmer was Mary of Drumflower 112, a daughter of Lochfergus Champion. This Galloway tribe was represented in a later day by MacKean's Prince Charlie 629, whose sire was a son of Lochfergus Champion and his dam a daughter of Victor 892.

Of a totally different race was Campsie 119 (1858-1874), a black horse, compact, short-legged, well-ribbed, but rather light in his forearm. He was first at the Highland and Agricultural Society Show at Kelso in 1863, and was held in great reputation throughout his whole career. A daughter of his became dam of the renowned sire Top Gallant 1850.

Samson 741 (1855-1872) made Clydesdale history in a very emphatic fashion. He was a somewhat undersized horse, a fact explained by his nickname, "Logan's Twin." He was a horse of beautiful symmetry and fine quality. Both his sire and dam were big animals, the former having won the Glasgow premium, while the latter was first as a yearling and second as a three-year-old at the Highland Society's Show in 1852 and 1854 respectively. He became sire of four of the most notable

breeding mares ever produced—namely, Darling, the dam of Prince of Wales 673; Keir Peggy 187, the dam of Darnley 222; Rosy *alias* Kate 104, the dam of Steel's Prince Charlie 628; and Hawkie, the dam of Old Times 579. These four horses left a permanent mark on the breed, and their influence remains not only in this country but throughout the world wherever Clydesdales are found.

Prince of Wales 673 (1866-1888) was bred by Mr. James Nicol Fleming at Drumburle, in Carrick. His sire was General 322, winner of first prize at the Highland and Agricultural Show in Inverness in 1865 when three years old. His dam, as already indicated, was Darling, also a winner of first prize at the same show as a brood mare. The sire of General was Sir Walter Scott 797. A long and furious controversy has raged regarding the origin of the two grand-dams of Prince of Wales 673. They have been currently reported to have been English mares, and the word "English" mares has been regarded as equivalent to the modern term "Shire." The facts are: both mares were grey; both were purchased in Cumberland by the late Michael Teenan, Dumfries, a well-known horse-dealer in his time. He brought them to Dumfries and sold them to the late William Giffen, a horse-dealer in Newton Mearns. Mr. Giffen sold the grey mare, which became the dam of General 322, to Mr. Buchanan, Wellshot, Cambuslang. Mr. Buchanan's manager was Mr. Wilson, and Mr. Wilson's son informed me that the sire of this grey mare was Merry Tom 532, the grey horse which came from Cumberland and won the Glasgow prize according to the statements made in an earlier part of this paper. The other grey mare Mr. Giffen sold to Mr. Robert Knox, Foreside, Neillston. Mr. Knox's son informed me at the East Kilbride show in 1881 that if the mare was an "English" mare his father never heard of it. The dam of General was named Maggie *alias* Darling. She won first prize at the Highland and Agricultural Society Show in Glasgow in 1857 as a brood mare. Darling, the dam of Prince of Wales 673, was bred by the above-named Robert Knox, and her dam, the other grey mare, so far as I have ever been able to learn, was not a show mare. Prince of Wales 673 had a distinguished show career as a three-year-old, a four-year-old, and again as a six-year-old. He was sold to the late Mr. Lawrence Drew when a four-year-old in 1870, and remained in his possession until Mr. Drew's death in 1884, when he was sold at the Merryton dispersion on 17th April that year for 900 guineas. I saw him sold. As a sire Prince of Wales early made his mark, and it would be simply impossible to give anything like a detailed account of the high-class prize-winning animals got by him. During the latter part of his career at Merryton he was largely mated by Mr. Drew with what are now recognised and known to have been carefully selected Shire mares. From these Mr. Drew bred a phenomenal number of strikingly handsome prize animals. Amongst the stallions of this kind the most outstanding was Prince of Avondale. During the latter period of his life (1887-1888) Prince of Wales 673 travelled in the Rhins of Galloway, leaving a large number of stock amongst which were some of the most outstanding prize-winners the

Clydesdale breed has ever known. Amongst his earlier produce a celebrated mare, Knox's Rosy, dam of Dunmore Prince Charlie 634, won first prize in four separate years at the Highland and Agricultural Society Shows, and in 1887, 1888, 1889 and 1890 his son Prince of Albion 6178 repeated the performance; and was sold as a two-year-old for £3000 to the late Sir John Gilmour, Bart. This was the highest price ever paid for a draught-horse up to that date. Size, style and action were outstanding characteristics of the produce of Prince of Wales 673. He himself had a somewhat straight hock and a good many of his produce were similarly affected. Also occasionally some of his stock were disposed to walk and trot rather wide behind; but in spite of these defects they were wonderful animals, as a rule up to a big size, with remarkable quality of bone. Mated with the female produce of Darnley in the Rhins of Galloway in the two last years of his life, the old horse left a remarkable percentage of show-yard animals, but unfortunately a number of them were rather undersized. They lacked the scale and growth necessary in draught horses.

The most outstanding animal of the Prince of Wales race since his own death has been Hiawatha 10,067 (1892-1915). This horse was bred by Mr. Wm. Hunter, Garthland Mains, Stranraer. His sire was a great horse named Prince Robert 17,135 (1887-1902). He was a son of Prince of Wales 673 and his dam was an exceptionally successful brood mare got by Steel's Prince Charlie 628. He won first in the open class for aged horses at the Glasgow Stallion Show in 1892, and in spite of being somewhat short in the rib, when mated with short-legged, old-fashioned Clydesdale mares he made his mark as a sire. The dam of Hiawatha was a lovely mare, Old Darling 7365, winner of numerous prizes at Stranraer show. Her sire was a local horse named Auchleach Tom 877. Hiawatha is entitled to be regarded as the greatest show Clydesdale on record. He won the Cawdor Cup on four occasions and was champion at the Highland and Agricultural Show at Edinburgh in 1899. As an individual he matured very slowly and during his first season he left but two foals. Gradually he improved in this respect and eventually proved himself to be one of the most successful and prolific sires. He was undoubtedly the first and the most influential of the modern type of Clydesdale stallions, "the tall horse" as distinct from the short-legged, thick, deep-ribbed horse. The older race of Clydesdale owners never spoke of a "tall horse"; their ideal was the "thick horse," the horse that was a big one when lying down. Hiawatha was himself in his later show-yard days quite thick enough, but he was always a tall horse, and has been happily described as the "Great Swell." His formation of feet and legs was simply perfect; his hind legs could not be surpassed in respect of formation. He was not specially distinguished for action, nor can it be said that his produce as a rule excelled in that respect. Amongst the most outstanding of his produce have been Labori 10,791, the first winner of the Brydon Challenge Shield; Marcellus 11,110, a beautiful horse which won the Cawdor Cup, and one of the most successful sires of brood mares in these later days; and Boquhan Lady Peggy 33,395, the

most lovely mare that ever won the Cawdor Cup. That victory came to her in 1910. There can be no doubt whatever that Hiawatha has been an epoch-making sire.

Another admirable sire descending from Prince of Wales is Royal Favourite 10,630, foaled on 6th May 1897 and still alive. He is a much thicker horse than Hiawatha and when mated with quality mares has proved a remarkably successful sire. His own sire was Royal Gartly 9844 (1892-1897), a great-grandson of Prince of Wales and winner of the Cawdor Cup in 1895 and 1896. Royal Favourite has been sire of two Cawdor Cup winners, Scotland Yet 14,839 and his own sister Harviestoun Phyllis 37,631.

Darnley 222 is a horse that awakens enthusiasm for the Clydesdale breed. He was foaled at Keir on 11th April 1872 and died at Blackhall on 30th September 1886. His sire was Conqueror 199 and his dam Keir Peggy 187, both already referred to. No more genuine Clydesdale ever existed than Darnley. As a show horse he came late to maturity, but when he came there he held the field. As a yearling he was second at the Highland and Agricultural Society Show in Stirling in 1873. He was first at the Glasgow Stallion Show in 1876 and 1877. He was first at the Highland and Agricultural Society Show in 1877 and champion stallion in 1878, and again first and champion stallion at the great centenary show of the Society at Edinburgh in 1884. He was second at the Royal International Show at Kilburn in 1879, being beaten by Druid 1120, and first at the Royal Show at Carlisle in 1880. He was a horse of a beautiful dark dapple brown colour with a white mark on his forehead and his off hind leg was white. Otherwise his marks were all dark. He had exceedingly good quality of feet and limbs, stood remarkably well up at the shoulders, with high withers, short back, but rather drooping quarters. His forearms were rather light and not too well developed in muscle, and his second thighs might have been better developed. His head was perhaps rather pony-like and he lacked the gaiety and dash of Prince of Wales when shown at the trot, but at a walking gait he had no rival. His stride was long and steady. To crown all, he was a horse with a beautiful temper, as mild and quiet as a lamb, and to his last day could be handled by a boy. From first to last he bred a remarkable succession of the highest quality stock. Like himself, they did not come early to maturity, but they were wonderfully true, sound in the feet, short in the limbs, deep in the rib, with genuine Clydesdale characteristics in the head and shoulders. It would be impossible to go over the succession of his produce. At the Glasgow show of the Highland and Agricultural Society in 1882 there was a competition for the best group of five animals any age got by one sire. Darnley led this group with his produce: MacGregor 1487, Top Gallant 1850, Sanquhar 2393, Clan Campbell 2675, and the first-prize mare Louisa 5841. In several seasons from 1884-1892 there were more district premium horses travelling which claimed Darnley as their sire than there were of such horses got by any other. Of the group above referred to, Clan Campbell was exported when two years old to Australia, but MacGregor, Top Gallant, Sanquhar and Louisa all left their mark on the breed. As a sire few horses

have ever excelled Darnley, and it is through the influence of his direct descendants that the modern Clydesdale has reached its present type and pre-eminence.

The most outstanding horse of the Darnley tribe during the eighties and early nineties of last century was MacGregor 1487 (1878-1899). He held his position at the top of the list of winning sires for many years. One of his most noted sons was Montrave Mac 9958, which died during 1919, having completed his 26th year. Flashwood 3604 (1883-1894) was an own brother to MacGregor. Both had distinguished careers in the show-yard, but MacGregor by far excelled Flashwood as a sire. The most enduring influence on the breed has come through Top Gallant 1850 (1877-1886), a horse of great size with a remarkably good forefoot and pasterns. In all his bearings he gave the impression of being a great horse. His weakness was a certain fleshiness of the hocks, a natural formation, not a disease. He was the best three-year-old of 1880, winning the Glasgow prize, the championship at the Glasgow Summer Show, and first at the Highland and Agricultural Society Show at Kelso in that year. When rising four years old he was sold to Sir Michael Shaw Stewart, Bart., for £1600 and remained in his possession until he died. He was not a particularly prolific sire. Nevertheless he left at least two stallions without which the modern Clydesdale breed would have been poorer. These were Sir Everard 5353 (1885-1898) and Lord Lothian 5998 (1884-1904). Sir Everard was bred by Mrs. Lamont, Killellan, Toward, Argyllshire. His dam was got by London Prince 472, a son of Prince of Wales 673 and a celebrated prize mare of her time, London Maggie 84. The back crosses belong to the old Clydesdale race referred to under the historical head of our subject. Both MacGregor and Sir Everard were purchased from their breeders for £65 a piece. As a two-year-old Sir Everard was first at Paisley. In the three seasons following he was first at the Glasgow Stallion Show in spring and was awarded the Glasgow premium. He travelled in Kintyre, Kirkcudbright, the Glasgow district and Banffshire. Everywhere he got stock whose influence abides. The three outstanding sires got by him were Baron's Pride 7122 (1890-1912), Sir Hugo 10,924 (1892-1915), and Sir Everest 10,917 (1898-1912). The last-named travelled in West Cumberland leaving excellent stock. Sir Hugo bred wonderfully well and at the dispersion sale of the Park Mains Stud the bulk of the animals were got by him, and forty-four head made an average of £131, 4s. 2d. Baron's Pride was the most outstanding sire the breed ever knew, until the appearance of his grandson, Dunure Footprint 15,203. He was bred by Messrs. R. & J. Findlay, Springhill, Baillieston, and was purchased by Messrs. A. & W. Montgomery in 1893 or early in 1894. He won first prize and championship as the best male Clydesdale at the Highland and Agricultural Society Show at Aberdeen in 1894. From 1896 until 1910 inclusive he held first place on the list of winning sires. He was only beaten by his own son Baron of Buchlyvie 11,263, and he in his turn was only beaten by his own son Dunure Footprint 15,203. Baron's Pride was on both sides of Darnley descent. He was a horse of marvellous quality with faultless feet and legs, a very fine top and beautiful

head and neck. His hind-quarters were carried well back. Like his ancestor Darnley he rather lacked muscular development in his second thighs. His limbs remained fresh and clean to the very end. He died on 20th December, 1912. For many years he and Hiawatha respectively occupied first and second places in the list of winning sires and the blending of their blood produced some of the most beautiful animals the Clydesdale breed has ever known. For masculine qualities and real draught character, as well as distinction in the show-yard, Everlasting 11,331 (1900-1917) is outstanding amongst the sons of Baron's Pride. He was first and champion male Clydesdale three years in succession at the Highland and Agricultural Society Shows—namely, at Inverness in 1901, Aberdeen in 1902, and Dumfries in 1903. No horse ever excelled him in popularity as a district premium horse and his reputation as a sire of sound produce is unsurpassed. Baron of Buchlyvie 11,263 (1900-1914) achieved high distinction in the show-yard. He was a horse of wonderful quality, with beautiful feet and legs, and exceptionally gay in his carriage. He was first at the Highland and Agricultural Society Show at Aberdeen in 1908. In 1911 for the first time he took first place on the list of winning sires, beating Baron's Pride, and this proud position he continued to hold in 1912, 1913, 1914. How long he might have held it no one can tell, but having had his leg broken in June 1914 he had to be destroyed. He was the subject of a prolonged lawsuit which ended in the House of Lords and as a result of which he was sold by public auction in Ayr market for £9500. To-day the leading sire of the breed is his son Dunure Footprint 15,203. In 1914 he stood second to his sire on the list of winning sires, and since then he has occupied an unrivalled position amongst Clydesdale sires. His terms for the present season 1920 have been £60 and £60. Another notable son of Baron of Buchlyvie is Bonnie Buchlyvie 14,032, which was sold by public auction in October 1915 for £5250. Of the Hiawatha race the most outstanding sire is Apukwa 14,567

Auction Sales.—The Clydesdale holds the record for prices realised at auction sales in the open market. On 14th December 1911 Baron of Buchlyvie 11,263 was sold by public auction in Ayr market for £9500. On 7th October 1915 his son, Bonnie Buchlyvie 14,032, was sold at the Seaham Harbour dispersion sale for 5000 guineas. The brood mare Dunure Glad Eye 39,839 was sold at Dene House Farm dispersion, Seaham Harbour, on 22nd April 1919 for 1850 guineas. The first female Clydesdale to make a four-figure price at public auction was Queen of the Roses 12,302 at the Montrave draft sale in April 1892, when she was rising two years old. She made 1000 guineas. At the Lanark Autumn Sales on 24th October 1919, the yearling colt, Record 20,157, was sold for £3400.

The following table of averages over a long period speaks for itself:—

<i>Date</i>	<i>Place</i>	<i>No.</i>	<i>Averages</i>
20th Oct. 1876	Knockdon	22	£209 15 2
7th April 1878	Merryton	50	168 11 0
8th April 1879	Merryton (partly Shires and "Crosses")	55	112 11 0
August 1879	Auchendennan (draft)	13	114 5 0

<i>Date</i>	<i>Place</i>	<i>No.</i>	<i>Averages</i>
April 1892	Montrave (draft)	29	£149 15 0
21st Feb. 1895	Eastfield (stallions only)	38	168 8 10
16th April 1896	Edengrove (Carlisle)	16	116 19 8
March 1900	Balmedie (dispersion)	18	110 6 2
23rd May 1901	Mains of Aires (dispersion)	19	141 7 9
30th Oct. 1903	Drumflower (dispersion)	9	134 12 8
9th March 1905	Blacon Point (draft at Lanark)	30	152 3 7
11th Oct. 1906	Blacon Point (dispersion)	14	206 10 6
17th Sept. 1907	Harviestoun (draft at Perth)	15	149 17 5
22nd March 1910	Seaham Harbour (dispersion)	77	117 14 10
11th Sept. 1911	Nether Bogside (Elgin)	19	108 7 6
6th Feb. 1912	Park Mains (dispersion)	54	131 8 2
9th Oct. 1912	Rachan (at Lanark)	15	147 8 5
13th Oct. 1913	Montrave (dispersion)	14	159 4 6
7th Oct. 1915	Seaham Harbour (dispersion)	100	211 17 4
4th Nov. 1915	Byres, Pollokshaws (dispersion)	6	146 6 0
Feb. 1916	Seaton Hall (mares)	6	196 0 0
9th May 1916	Uppermill (dispersion)	23	106 16 6
10th May 1916	Crannabog (dispersion)	20	127 5 8
18th May 1916	Balgreddan (dispersion)	12	146 10 0
6th March 1917	Dunure Mains (draft)	47	323 18 8
25th Sept. 1917	Balcarn (dispersion)	22	187 3 9
5th March 1918	Banks Stud (stallions, at Lanark)	25	557 19 5
23rd May 1918	Bombie (mares)	18	183 17 4
24th Sept. 1918	Carskief (dispersion)	15	204 4 0
16th Oct. 1918	Pallat Hill (dispersion, stallions)	8	411 9 4
14th Jan. 1919	Dunure Mains (dispersion, stallions)	13	1676 7 4
13th May 1920	Auchneil, Stranraer (dispersion)	12	372 1 8
8th Oct. 1920	Boquhan (dispersion)	40	317 8 3
11th Oct. 1920	Dunure Mains (dispersion)	28	312 2 1
13th Oct. 1920	Farlton (dispersion)	19	408 13 8

The last three sales were composed almost wholly of mares and fillies.

Exportation.—For nearly a century the Clydesdale has been exported in greater or less numbers to Australia, New Zealand, Canada, the United States of America, South America, South Africa and nearly all the countries on the Continent. In pre-war days large shipments of fillies were made from time to time to Germany and Russia. Prior to 1880 the export trade was chiefly carried on in the way of purchasing a few of the leading horses and mares in the show-yards. During the past forty years the trade has been in numbers rather than in quality; and during the ten years preceding the Great War a very large trade was done with Canada. In some years the numbers exceeded 1000 head, high-water mark being reached in 1911, when the number of export certificates issued was 1617. Since the war half-a-dozen exceptionally high-class mares and stallions have been exported to Canada, the prices of which have been as high as £3000 each.

THE WOMEN'S SIDE OF A RURAL POLICY.

ELIZABETH B. MITCHELL, M.A.

THE Committee on Women in Agriculture in Scotland,¹ whose Report is now published (H.M. Stationery Office, 5s.), had access

¹ The Committee was originally appointed by the Ministry of Reconstruction, but was almost at once transferred to the Board of Agriculture for Scotland,

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— ENQUIRIES WELCOME —

through its twelve members to a remarkable variety of knowledge and experience in connection with agricultural life in Scotland; and the list of witnesses and the evidence quoted in the Appendices show that all sections of the agricultural community, as well as educationists, medical men and others in touch with country conditions, were most generously willing to put their knowledge at the service of the Committee.

The result is now available to the public in a full and careful Report, signed by all the members, dealing with agricultural life for women under many aspects, and in a series of valuable Appendices containing selections from the material presented to the Committee. Appendix III. gives extracts from evidence heard at sittings in Edinburgh, and also at Inverness and Fort William; Appendix IV. gives a record of local inquiries carried out in different districts by delegations from the Committee, illustrating particular aspects of women's life in the country, as, for instance, the family system of farm service in Berwickshire, the work of the "in-and-out" girl, a country school imbued with rural spirit, housing enterprise on a great estate.

Never before was the women's side of agricultural life in Scotland made the subject of a comprehensive inquiry; the nearest approach to one is recorded in the Reports of the Assistant Commissioners of the Commission on the Employment of Children, Young Persons, and Women in Agriculture (1867). The truth is that women's contribution to agriculture, even from a severely economic point of view, is much underestimated in official returns owing to the immense amount of agricultural work done by women who are not full-time wage-earners. Three types of such incompletely recognised contributions are enumerated in the Introduction to the present Report: (1) the dairy and byre work of the farm domestic servant; (2) the constant work of wives and daughters on the small farms, culminating in the work of women on those crofts where the men work at the fisheries or elsewhere; and (3) the occasional and part-time help given by the wives of farm servants. "Throughout, the available statistics underestimate the contribution of women to agricultural production, both in the past and at the present time."¹ The point of approach to the subject of inquiry is the fall in the agricultural population of Scotland between 1861 and 1911. The census figures for women *employed* in agriculture² being dismissed as hopelessly incomplete for the reasons given above, "the only reliable evidence for estimating the trend of numbers in the agricultural population of Scotland is that afforded in the tables of 'males engaged in agriculture.' The fall there in fifty years is 30 per cent. . . . It and the Report is addressed to and published for the Board. The list of members was as follows:—

Mrs Charles Douglas (*Chairman*).

Miss Agnes Campbell.

James Gardner, Esq.

Miss Bella Jobson.

Mrs John Notman

The Hon. Mrs Stirling, O.B.E.

J. M. Caie, Esq.

Miss Ada M. Crabbie.

T. Henderson, Esq.

Alexander McCallum, Esq.

Miss Mary M. Paterson, C.B.E.

Miss Alice Younger, O.B.E.

¹ Unless otherwise stated, all quotations are from the text of the Report. In quotations from the Appendices the references are given.

² 40,653 in 1861, falling to 15,037 in 1911.

should be noted that in the fifty years from 1861 to 1911 the total population of Scotland rose from 3,062,294 to 4,760,904. The proportion of males engaged in agriculture to the total population therefore fell from 6·87 per cent. to 3·11 per cent." The war period concentrated attention on women in agriculture and arrested the decline in the numbers of women employed, but did not bring recovery. "In spite of the suspension of emigration . . . even the patriotic appeals addressed to women in 1917-18 still left the figures in July 1919 below the 1914 level."

The Report does not elaborate the point; in a more popular work it might have been well more explicitly to expose the fallacy in the complacent belief still common that the country districts of Scotland are the providentially appointed perennial source of fresh life for the towns and the Dominions. On this theory the constant exodus of young people from the country is right and natural; its weak point is the proof in the admitted figures that the source is running dry.

The Committee recognise this wasting away of the life of the country as something both dangerous to national well-being and unnatural in itself, in view of the economic recovery of agriculture now in process, and the unsatisfied demand for women workers with country experience in nearly all districts; and thus as calling for searching and comprehensive examination, and for sustained effort towards a cure. No one-sided remedies can be expected to suffice, to recruit new workers for agriculture is of little use while the girls born and bred on the land will not stay on it. The conditions of rural life as a whole are necessarily included in the scope of the inquiry, which is defined in three interrelated questions—"why the general conditions are so unacceptable to young women, even when country-bred, how rural life may be made more attractive to them, and how they may best be prepared to take a part in it beneficial to themselves and to the nation."

The chapters of the Report thus introduced include a preliminary note on the Health of Women Agricultural Workers, based on the replies of eighty-three representative country medical practitioners to questions circulated by the Committee; next come Housing, Wages and Conditions of Work of Wage-earning Women, Family Work, Prospects of Women, Women's Work in the Highlands, Industries Complementary and Subsidiary to Agriculture, and Co-operation, all dealing more or less with the economic and material side of things; the two chapters which follow, on Education (Primary, Secondary, Technical and Adult) and on Social Life, touch the less material needs of the human being. The final chapter contains general conclusions, with detailed recommendations on most of the subjects discussed. It is characteristic of inquirers who sought above all to gain an all-round view of their problem that, of the two requirements finally picked out as fundamental for any scheme of rural restoration, one should be in the outward surroundings of the worker, the other in the preparation of the mind—improvement in housing and in education.

Health.—The note on health is brief and prefatory. It clears

out of the way the belief sometimes held, especially in England, that processes of outdoor agricultural work performed by women in some parts of Scotland are *in themselves* too hard for women's health. On the contrary, "the medical opinion on the whole confirms the view that country-bred women are generally superior in health and vigour to town-bred women, and that agricultural work is a good preparation for motherhood." It condemns, however, such work by married women as may lead to neglect of home and family, even though not necessarily having a bad effect on the women's own health. In Scottish agriculture, it must be remembered, apart from the employment of farm servants' wives for two or three hours per day as milkers, far the greatest item in the sum of work by married women is that contributed by the wives of crofters and small farmers, not by wage-earners.

Housing.—In Housing, the Report enters on difficult ground. For the general facts the reader is referred to the Report of the Housing Commission. Emphasis is laid on the difference of conditions in different parts of Scotland. "In some districts there is such a general scarcity of accommodation for married farm servants as to explain any degree of rural depopulation. . . . Elsewhere, again, cottages exist, but a very large proportion are old, damp, and without modern conveniences, and contain only two rooms. Where the cottages are on the whole larger, as in the south-eastern districts where farming is most industrialised, many of the cottage rows and their surroundings are exceedingly dreary and unhomelike. . . . In some places the housing is good. Some of the houses seen by delegates from the Committee in Berwickshire were dry and in good repair and had four rooms, or three rooms and a garret store-room, also pantries, and sometimes milk-houses. Remarkably good houses (both as to comfort and attractiveness) were being built before the war on some estates." On this last point Appendix IV. contains an account of pre-war housing enterprise on an estate in Dumfriesshire, which may seem almost incredible to those familiar with farm workers' houses elsewhere.

The direct effect of bad housing on the family, and therefore peculiarly on women's comfort and on young women's attitude to agricultural life, is obvious. Young women *cannot* stay at home if there are only two rooms. (A later part of the Report shows clearly that even at the present day, when the slackening of the family tie is so much deplored by moralists, girls are much more willing to stay in agricultural work if they can live at home, while, if they must leave home, they would sooner go to town than to service on a farm.) So also discomfort such as that due to the lack of a water-supply—very often quite easily curable—must prejudice the younger women against the prospect of settling as workers and as wives in the country. The younger generation will not acquiesce in conditions accepted by their parents. The mention of isolation as a factor in discontent and of the unhomelike and unattractive appearance of some of the cottage rows lead to the first mention of the "shifting" so common in many districts—a subject which recurs like a refrain through the Report.

This is perhaps the key-problem of all connected with the life and status of Scottish farm servants. Constant change of place has a ruinous effect on the comfort, the education, and the social and other opportunities of the rural worker's family. The house of migratory workers is not a home but a lodging. "There is an obvious connection between the dull unhomelike house with its bare potato-patch and the habit of frequent shifting. . . . No doubt it is true that the habit of shifting makes occupants careless of their houses, and also that a bad house or even a commonplace unattractive one makes the occupants more willing to move. . . . A vicious circle exists, which it is essential to break." Fruit bushes and hens in a farm worker's garden are both satisfactory signs—they imply some permanence. The excellent housing described in the Dumfriesshire Inquiry (Appendix IV.) is found along with a habit of long service. On this subject of shifting, the Berwickshire Inquiry is particularly interesting, showing the assumption by some of the women that a family move at least once a year is in the natural course of things. Isolation and lack of social life create apparently a craving for change in itself resulting in an aimless migration, which in its turn renders it all but impossible for interests to be developed. All means that may help to break the vicious circle, and link the farm worker and his womenkind with other lives and interests, are so far of value—and among the appropriate means must certainly be included better, more attractive, and more sociable housing.

On the question of the "tied house" difference of opinion in the Committee can be traced, and a minority have added a note condemning the system. The summing up by the undivided Committee is as follows:—

"We are impressed by the extraordinary contrast between the migratory life of ploughmen's families in some districts of Scotland on the one hand, and on the other, the settled permanence characteristic of the homes of villagers and small-holders; and we think that one of the contributory factors in creating the different customs is the sense which the second class generally have and the first have not, of being at home in their own houses.

"We believe that the provision for the use of the agricultural population of a certain number of 'free' houses under the control of the Local Authority, and situated in groups at convenient central spots, would, in some measure, relieve the situation, not only for those who may inhabit the houses, but also for those in the 'tied' houses in the neighbourhood, who would then feel that they had some freedom of choice."

The note at the end of the chapter has not lost in force during the ten months since this Report was drawn up. . . . "We believe that the provision of new houses in large numbers is of the greatest urgency in many rural districts. So far very little progress has been made to supply this need; we wish to emphasise our opinion that until this need has been met, no other schemes for the arrest of rural depopulation can be fully effective."

Wage-earning Work.—The discussion of Housing obviously points forward to the final chapter on Social Life; but first, in

Chapters IV. to IX., questions of work and its reward must receive attention. Chapter IV. differentiates wage-earning women into three classes :

- (1) Whole-time regular workers, not domestic (outworkers and byre women).
- (2) "In-and-out" girls, whose work is partly domestic, partly in byre and dairy, occasionally in the fields.
- (3) Part-time and seasonal workers (of whom many are married women, wives of farm workers).

The first class have a regularity of conditions more or less like men's. Outworkers are chiefly found in the south-eastern counties. The family system of engagement still surviving there is illustrated in the Berwickshire Local Inquiry (Appendix IV.) and will surprise many unfamiliar with that part of Scotland. Wage-rates are on the whole low compared with those of other industries and the cost of living. The practice of hiring in families (the women often not themselves attending the hiring fairs) has tended to keep wages down.

The "in-and-out" girl was proved during the war to be a "pivotal" worker in most of the farms of Scotland. "They live in the farm-houses, and are expected to do different kinds of work—house, dairy, byre, and in some districts field work—as may be required. There are no fixed hours nor any generally recognised customs as to holidays. Obviously, in such a system of service a great deal depends on the individual employer, and conditions of work vary enormously from farm to farm." As to the work of this class the Aberdeenshire and North Lanarkshire Local Inquiries supply notable evidence. In the north-east the conditions are extraordinarily hard, with a working day, apparently, of fourteen to sixteen hours. Farther south, the worst cases were on farms near large towns supplying warm milk to town dairies—this necessitated milking as early as 2.30 or 3 A.M. "No valid reason can be given in defence of this arrangement. . . . The custom . . . has fortunately fallen into disuse to a great extent . . . during the war, and it is to be hoped that its revival will be prevented—by legislation if necessary." Generally, however, "in all districts the hours worked by the in-and-out girls are long, in many cases excessive." The necessity of milking at intervals of roughly twelve hours inevitably involves a long day, but fixed leisure time between milkings could be provided. "The general conditions of their work are less satisfactory than those of other workers on the farm, and their hours are longer than those of anyone else—except, perhaps, the farmer's wife."

A comparison between the outworker and the in-and-out girl indicates that the rate of wages, though an important factor, is not the only nor even the main cause of the unpopularity among women of agricultural work. "In wages the outworker usually earns less than the in-and-out girl, although her work is equally hard and involves more exposure to weather; yet, though workers of both kinds are scarce, those of the latter class are much the most difficult to find, even where their wages have risen highest.

... That outworkers are able to live at home is probably a strong incentive to them to remain 'on the land,' and the regular hours give them free evenings and fixed holidays." As to the in-and-out girl, "of all kinds of women's labour in agriculture, this is the most difficult to obtain. This state of matters must be attributed to the conditions . . . and chiefly to the length of her working day and the lack of fixed and regular leisure time. Unless employers can be brought to recognise that the demand of their women workers for better opportunities of recreation and social life is legitimate and must be met, there is no hope of retaining labour of this class in the agricultural industry; discontent with prevailing conditions will continue to show itself in a steady drift to other employments." Further, the conditions are often such as to give the occupation a bad repute, so that "parents and advisers of young girls are often, and naturally, averse to their taking such employment." "It is in the best interests of the agricultural industry that voluntary action should be taken at once and as thoroughly as possible. We are sure that good employers would welcome such action."

The recommendation is that local Conciliation Committees of employers and workers should deal with the conditions of the in-and-out girl as matter of urgency, and also with the wages of the outworker. This, the Committee believe, might give far better results than the State regulation foreshadowed in the Astor Committee Report and inevitable if voluntary agreement should fail.

Family Work.—The Family Worker (Chapter V) often has to endure all the material hardships of the wage-earner. As with the "in-and-out" girl, much of the work done by this class is ignored in official returns and sometimes even in agriculturists' thoughts. "'On the small farm the woman is much more the partner of the man in his business than in any other industry I know of' [Sir R. Greig]. On the smaller farms, as well as on crofts and small holdings, it is no exaggeration to say that the work of wives and daughters is at the least as exacting as that of the men." "The right and natural reluctance to interfere with family life has been a deterrent to investigation, and only those who come in contact with the life of the small farms have any real knowledge of existing conditions."

The system has many social advantages. The value of home life and the country girl's love of home (*cf.* above, p.) are strong points in its favour. But there is a degree of strain to which this strong love of home should not be subjected. "There can be no doubt that fair consideration for the work of sons and daughters is very often not given, and that their future, especially that of the daughters, is frequently sacrificed to the immediate needs of the family as a whole." This must be recognised as an influence telling against agricultural life in the minds of young women choosing their career. A fact noted, though not fully discussed, is the tendency of unpaid family work to lower the customary wage-rates for female labour generally in agriculture, especially in dairy-farming.

Family work in agriculture is carried, of course, to its extreme point in those crofting districts of the Highlands and Islands (Chapter VII., Highlands) where the men make the bulk of their earnings in connection with the fisheries, sport, etc., and the work of the croft is mainly done by the women of the family. In Shetland "when ploughing is done it is done by men, but a great many of the crofts are derved; the women do that. There ought to be more horses; the girls work too much in the old way. The women do the peat-carrying; that is terribly hard work, and there are some parts where you can't take a pony," (Appendix III. Miss Coutts).

Yet "in the Highlands the problem is less how to retain in rural life women who are anxious to leave it than how to enable women who desire to remain on the land to earn a sufficient livelihood." It is clear that, among wage-earners, small farmers and crofters alike, in order to be at home or near home the average girl will acquiesce in conditions which she would otherwise reject. The remarkable description in Appendix IV. of hard service by an Aberdeenshire kitchen-girl and housemaid gives an explanation why any girls are willing to serve on such terms. "Girls go to farm service soon after leaving school when their parents want them to be near home." If the family affection of daughters could be given a fair chance by improved housing and a certain adjustment to modern conditions in the point of view of parents, it would act even more strongly than at present to retain the country girls in the country.

Prospects of Women on the Land.—The chapter on this subject is short. The fear of possible unemployment among agricultural women from the further improvement of machinery is dismissed. The result would be rather to reduce the length of their working day—a much-needed improvement. Prospects beyond wage-earning employment are not, however, so clear. As Principal Paterson says (Appendix III.), "there is not such a good agricultural ladder for women as there is for men"—and even the men's ladder in some districts has rungs missing. Even apart from the scarcity of small-holdings, and the difficulty of securing adequate training, women workers can hardly save capital out of the wages they receive. For women in agriculture, in fact, unless they are born farmers' daughters, the chief existing agricultural ladder is by way of marriage. "There is, as far as we can see, no reason why women should not engage with success in the highest developments of practical agriculture—in many instances they have already done so. These instances have hitherto been confined in large measure to women who were compelled by circumstances (in most cases the death of husband or father) to undertake the direction of farms . . . but there can be no doubt that the success of innumerable farms is due to the work done and the responsibility shared by husband and wife in partnership." For women holders, dairying and the smaller agricultural industries, especially in suitable combinations—pig-rearing, fruit-farming, poultry-farming, market-gardening, bee-keeping, goat-keeping—are held to offer the best prospects. In all these branches

co-operation among producers offers a greatly improved prospect of success. Interesting evidence is given by Miss Cairns, Miss Irwin, Miss Morrison and Miss Niven, as well as by Mr. Douglas, Mr. Drysdale, Sir R. Greig, and Mr. MacNeillage, as to women's success in farming.

Agricultural science is noted as another line of advance open to able and well-trained women.

Rural Industries.—At two points in the chapters so far considered—on the problem of a supply of seasonal workers for large-scale agriculture and on that of securing a supplementary income for families on small crofts—there is a reference forward to the chapter dealing with Industries Complementary and Subsidiary to Agriculture (Chapter VIII.). In some parts of southern Scotland people are now so scarce that there is no local reserve from which occasional labour for seasonal processes in agriculture may be drawn, and farmers are thrown back on the services of married women (*cf.* above, p.), and of itinerant gangs, with the notorious housing difficulties involved. In this connection striking evidence (of which the whole should be read) is quoted from Lord Lovat and from Mr. H. I. Wilson, H.M. Superintending Inspector of Factories. The latter shows how the villages, with their small-scale industries, used to provide a pool of occasional labour for the seasonal needs of agriculture; and how these industries (*e.g.* breweries, flour-mills, paper-mills, wood- and pirn-turning mills, tanneries, fell-mongering, small coach-building, coach-painting, saddlery and harness-making, tailoring, boot- and shoe-making, watch- and clock-making) have been disappearing from the villages during the last generation. The war, however, he points out, may mark a turning-point. War experience proved that many articles (and parts) can be made in quite small scattered workshops, if made to exact sizes, quite as well as in large, well-equipped factories. Such distribution of industry outside of the congested centres would benefit the health of the industrial worker and at the same time offer variety of work and additional social opportunities in the rural districts; local utilisation of water-power now running to waste offers one obvious means towards this end. A passage in Lord Lovat's evidence (Appendix III.) fits in with the above: "The aluminium works at Foyers and Kinlochleven have done good to the districts concerned. Such new places always have a bad name at first, and have a floating population that comes and goes. Now Foyers has probably about 90 per cent. of Highland people." Plainly one of the chief obstacles to such decentralisation of industry, desirable in everybody's interest, is the problem of finding housing for the workers outside of the great centres. No policy which omits to face and master this difficulty can be effective.

The special Highland need for industries arises from the fact that "the smaller croft cannot be ranked as a self-supporting agricultural holding—it is really the family home; on these 'the crofter is not an agriculturist, he is a labourer with land.'" Thus employment in complementary or subsidiary industries is needed to provide a money income. "At present fishing is the only industry which employs any large number of Highland men and

women; in the seaboard areas it is undoubtedly still capable of great development. For the inland areas, the extension of forestry is generally considered to offer the most hopeful solution of the problem of employment. . . . Employment given ranges from light work, suitable for women and boys, up to the heaviest work for men. . . . The outstanding advantage of forestry is that it gives work just at the time when labour is not required upon the croft, and, provided that men's labour is available for part of the year, employment can be given to women practically all the year round." In forestry areas, with the water-power of the valleys utilised, many industries could be locally carried on—"bobbin- and pirn-milling, cabinet-making, and the manufacture of by-products from the distillation of wood." Basket-making is a hand industry which should be promoted where osiers can be grown, as in Skye.

Mechanical power or water-power in small units could also be applied to some of the existing home industries both in north and south (spinning, weaving, glove-making, hosiery-making, etc.), thus providing a more productive and also more sociable form of work than the strictly home industry, one which might appeal specially to the younger women (see evidence by Miss Anderson, Golspie, Appendix III.).

It is recommended "that schemes should be promoted for the utilisation of water-power in rural districts in view of its importance in the development of rural industries, and that any larger schemes for the transference of such power should be framed with most careful consideration for local needs and possibilities."

Of existing home industries the most important are the Highland home-spun tweed and the Shetland hosiery industries. Both produce at their best a first-class article which can hold its own in the open market; but both suffer severely from imitations and from the lack of a guaranteed standard of material and workmanship in the goods themselves. In Shetland "there has recently been a tendency to cross the native breed of sheep with other breeds in order to obtain greater size. This crossing impairs the quality of the wool, and in the best interest of the Islands care should be taken that the pure breed of Shetland sheep be maintained." For Shetland the evidence of Mr. A. F. Smith and Miss W. Coutts should be read. For full treatment of Home Industries in the Highlands and Islands the reader is referred to Professor Scott's Report [Cd. 7564]. The Committee strongly recommend the promotion of co-operative business organisation and of the effective use of trade-marks to distinguish (*a*) tweeds and hosiery made entirely by hand, and (*b*) those made partly by hand and partly by machinery. Good technical instruction, in continuation classes or otherwise, is also desirable.

Co-operation.—To the development of Co-operation (Chapter IX.) the Committee look for the solution of some of the sharpest problems for women in agriculture and agricultural industries. The co-operative milk depots of Ayrshire (affiliated to the Scottish Agricultural Organisation Society) have not only proved most profitable to their members, but have eased the almost intolerable

working day of the women on the dairy-farms. "In this connection it is to be hoped that a much larger measure of assistance than hitherto will be given by the State to propagandist work in developing co-operation." In the minor forms of agricultural production (poultry-keeping, market-gardening, etc.) specially suited to women holders, co-operation makes an enormous difference, instanced in the remarkable development of co-operative poultry societies in Shetland. "It may almost be said that the smaller the industry the greater the benefit to the worker of co-operative buying and selling." The hand-made hosiery and tweed industries have not yet been organised co-operatively on a large scale, but such organisation offers the best prospect of combating the weaknesses from which these industries at present suffer.

The Committee sum up as follows on the closely related subjects of Industries and Co-operation :—

"We wish to emphasise the point that co-operative organisation in agriculture is a benefit to producer and consumer alike; larger profits to the producer are secured by the elimination of waste, and the consumer benefits by the increased quantity of good produce placed upon the market.

"We regard subsidiary rural industries as a desirable element in the rural life of the Lowlands, and as essential to the prosperity of the Highlands. In the past much good work has been done in the Highlands by those who have interested themselves in this matter, but their work has failed of full effect through lack of co-ordination and insufficient business experience; an additional difficulty is the lack of effective means of transport. The present state of matters cannot be regarded as satisfactory. We suggest that steps be taken to investigate the possibilities of applying co-operative organisation to industries already existing in the Highlands, and, if advisable, to suggest other schemes of development.

"As regards the development of rural industries in the Lowlands, a conference of those interested might usefully be convened.

"We believe that the recent revival of prosperity in agriculture offers more hopeful prospects of success than in the past for efforts in this direction."

Education.—In Chapters X. and XI. the point of view changes. The subject of inquiry is no longer the house in which the country woman lives, the work she finds to do, the wages or other recompense she receives for doing it, but the mind of the country girl herself, and its preparation for and relation to the life before her.

And here it appears that there is a gap which goes far to explain the wasting disease from which rural society in Scotland has suffered. On the one hand, the conditions of life in the country in many respects have not been such as to attract young people sufficiently educated to make their way elsewhere; on the other, the education given in country schools is, in fact, in too many cases, out of relation with rural life either as it is or as it might be. "We believe that in a very large number of schools

the policy of relating instruction to environment has not yet had practical effect . . . and that, wherever the blame may lie, the accusation brought against the country school of being, in fact, out of relation with rural life is too commonly justified." In their final summing up in the last chapter of the Report the Committee lay stress on developments in rural education, as on improvements in housing, as the two most fundamental necessities for any scheme of rural revival.

They are careful to guard themselves from the suspicion of wishing to narrow the country child's education. "We desire to dissociate ourselves absolutely from the view still sometimes held that the agricultural worker's child is better without much education and that what he or she does receive ought, from an early age, to be chiefly in special agricultural subjects. We believe that education . . . should in the first place aim at the development of character and ability rather than at fitting the child for a particular industry. . . . At the same time we believe that general education does not lose in value but gains from being related to the life around the child."

This chapter of the Report and also the evidence on Education is particularly detailed and cannot be well summarised. The section should be studied in full by all interested. Various suggestions are made as to the books and curriculum of rural schools, and especially as to the value of school gardens, in which girls as well as boys should have a share. In the teaching of literature and singing "more use might be made of Scottish ballad and lyric poetry." Handicrafts should be encouraged. As a solution for the puzzle of the teacher's time-table in small schools a system of central rural schools is proposed for the more advanced pupils, with the proviso that arrangements should be made for their daily conveyance from their homes. But the question is at bottom one of spirit and intention in the teacher. "Important as questions of arrangement are, the personality of the teacher and the direction of his or her interest is the chief thing; and this is proved by the fact that certain teachers triumphantly succeed in spite of all difficulties in giving an education full of rural spirit." The country school needs a very good teacher, as he or she has to teach everything to the children at many different stages; and he or she should be interested in the country. It is noted that the National Salary Scale of August 1919 does not sufficiently consider rural interests. The needs and importance of rural education ought to be pressed on Education Authorities.

Secondary schools often tend at present to draw away the interest of the brightest country children from country to town. "The Canadian experiment of Agricultural High Schools should be studied, and something of the kind set up in this country at selected rural centres, preferably where there is already a good secondary school, but not in towns of any great size."

Technical training in agriculture should be made more generally available for girls and women by an increase in the number of itinerant instructresses from the agricultural colleges, and by setting up dairy institutes in the different counties or districts. At present "in few countries is the technical instruction

of women in rural industries so deficient as in Great Britain. . . . The present facilities are inadequate for training girls in those subjects which would be most useful to them if they follow a career in the country" (Sir R. Greig). Domestic economy should be included in the curricula for girls.

By such a rural education as outlined the young people would have "their eyes opened to the interests and the possibilities of the life around them; and if anything is felt to be wrong or out of date in the organisation of country life, it may be expected that young men and women so trained will set themselves to change these features rather than choose the more customary but nationally disastrous alternative of abandoning rural life."

Social Life (Chapter XI).—A full and interesting social life may be found along with great poverty and in remote spots, as in certain parts of the Highlands. Over the greater part of rural Scotland, however, the lack of social opportunities appears to be the most deeply felt lack of all. A witness unlikely to make too little of wages, housing, tenure, etc., goes so far as to declare that "social life is the key to the whole question of rural depopulation." Practically all the witnesses questioned on the subject agreed that the lack of social life in the country is at least one of the chief causes that drive away young women to the towns.

The extreme point, of course, is reached where shifting is commonest—where the woman in the farm cottage does not know the next-door neighbour; where old church connections drop and new ones are not formed; where it is not worth while to join a Union Branch or a Women's Institute "because we may be away again at the term"; where there is no object in brightening up the house or planting anything but annual vegetables in the garden; where the very children can hardly grow accustomed to a new teacher before the family is off again—in half-conscious search, apparently, for some relief to the monotony inherent in such a life. What this isolation means in loss of happiness, purpose and prospect for the future may be readily understood. Where shifting is customary anything whatever that will help the farm servant and his family to strike root and form connections is of value. Development of village or group housing, opportunity to secure a bit of ground free from restrictions as to its use, more preparation for social life at school, more countenancing by the older people of the young people's amusements, the growth of Women's Rural Institutes, Union organisation, co-operation, educational societies—all or any of these would so far tend to lift the feeling of deadness and depression which at present seems to weigh down upon the young people in many country districts and to drive them either to town or to a futile wandering from place to place; and the more the country people acted together in such ways, so much the better they would be able to go on. "Social life cannot be created by legislation; what the State can do is through various means, material and educational, to create conditions favourable to its growth." "The difficulties besetting all efforts to regenerate rural life in Scotland are sure to be many and great. 'No one can deny that our complicated state of society at the

present time is far too much split up by cleavages due to varying interests, party politics, different churches, cliques, societies, etc.' But however formidable these difficulties may be, there can be no doubt that the future development of the agricultural industry will depend largely on the development of organised Social Life."

Conclusion.—The conclusions (Chapter XII.) have been already freely quoted. "The work of women in agriculture is, in Scotland, so important a factor in the prosperity of the industry that it ought to receive fuller and more explicit recognition than has hitherto been the case. To this end, we consider that women should be represented on executive, administrative, advisory and educational bodies which deal with agricultural interests."

For any practical scheme for rural development, improvement in housing and in education is a necessary first step.

Questions of wages and hours, it is hoped, may find an agreed solution through the action of Conciliation Committees—"the present state of matters cannot long continue."

Whole-time agricultural work (either regular or seasonal) by women with families is an evil.

Co-operation, and rural industries which only co-operative methods can make economically sound, would give variety and opportunity to life in the country, and are especially important for the prospects of women.

Wider social opportunities would bring increased interest, enjoyment, and effectiveness of action into the lives of Scottish country women.

To carry out the recommendations made the Departments of State concerned should give the fullest encouragement, by advice and practical assistance, to all approved voluntary agencies working for rural development.

Forty-one detailed Recommendations are made.

The Committee did not consist of Utopian idealists. They based their proposals for the women's side of a rural policy on two hard facts—that young women are as a matter of fact disappearing from country life as it is, and that the restoration of country life in Scotland has now become both economically and socially urgent. Effort from many directions is required to effect the necessary restoration.

THE AGRICULTURE ACT, 1920.

THE Agriculture Act became law on 23rd December 1920, and came into force on 1st January 1921. Originally introduced in May 1920, it was exhaustively discussed in the House of Commons and in the country throughout the summer and autumn, and its provisions had been materially altered when it finally left the House of Commons on 23rd November. The House of Lords introduced drastic changes, most of which were accepted by the House of Commons in the course of sittings and negotiations

that lasted almost continuously from the evening of Wednesday, 22nd December, until midnight on Thursday, 23rd, when the Bill received the Royal Assent. These circumstances are of importance. Generally speaking, it is sufficient in dealing with an Act of Parliament to describe its actual terms, but where, as in this case, the intentions of the Government, supported by the House of Commons, have on fundamental points been over-ridden by the House of Lords, it is necessary to refer to the earlier provisions of the Bill, which were before the country for six months, and which formed the basis of the discussions mentioned above.

The Act is divided into three parts. Part I. amends the Corn Production Act, 1917; Part II. amends the Agricultural Holdings Acts; and Part III. contains general provisions. The sections of outstanding importance are—in Part I., Section 2 (minimum prices) and Section 4 (control of cultivation), in Part II., Section 10 (compensation for disturbance); and in Part III., Section 33 (4) (rules of good husbandry) and Section 34 (application to Scotland). These sections should be closely studied both in the form in which they left the House of Commons and in that which they have finally received; this does not, however, apply to Section 2, which remained unchanged.

The Act was originally intended to apply to Ireland, but in view of the almost simultaneous passing of the Home Rule Bill this provision has been deleted.

It should further be pointed out that the Act is a complicated piece of legislation by reference, and that its application to Scotland involves numerous material as well as formal points. No attempt is made here to deal exhaustively with the provisions of the Act and their bearing on previous Acts. The scope of this article is limited to a brief account of the main features of the Act. Copies of the Act may be obtained from H.M. Stationery Office, 23 Forth Street, Edinburgh, price 6d. or by post 7½d.

PART I.—AMENDMENT OF THE CORN PRODUCTION ACT, 1917.

Part I. provides that the Corn Production Act of 1917 shall be permanent (Section 1). If, however, an address is presented by both Houses of Parliament praying that it may cease to be in force, the King may by Order in Council make a declaration to that effect, and the Act will expire at the end of the fourth year subsequent to the year in which the Order is made, with reservation of all rights accrued and liabilities or penalties incurred before the date of expiration.

Considerable alterations are made in Part I. of the Act of 1917. The method of determining the amounts, if any, payable to growers of wheat and oats is unaltered, but the method of fixing the minimum prices on which these amounts are based is quite changed. Instead of laying down a schedule of prices for each year, the new Act provides for the appointment of three Commissioners to determine these prices (Section 3). One of these is to be appointed by the Minister of Agriculture and Fisheries and the Board of Agriculture for Scotland jointly, one by the Treasury

and one by the Board of Trade. They thus represent respectively the producer, the tax-payer and the consumer.

The year 1919 is taken as the "standard year" by reference to which the Commissioners are to make their calculations (Section 2). The minimum prices for the standard year are laid down as follows:—

Wheat, 68s. per customary quarter of 504 lbs.

Oats, 45s. " " " " 336 " .

The corresponding prices per "statutory quarter" are for wheat 64s. 9d. (480 lbs.) and for oats 42s. 7½d. (312 lbs.). The Commissioners are to ascertain the cost of production of wheat and oats in each year, and to fix the minimum prices per statutory quarter at figures bearing the same proportion to those for 1919 as the cost of production in the year under consideration bears to the cost of production in 1919. For this purpose they are to obtain such information as they can from the Minister of Agriculture and Fisheries, the Board of Agriculture for Scotland and the Department of Agriculture and Technical Instruction for Ireland (which is here left in, apparently by design), and from individuals. They have, however, no power to compel anyone to appear before them or to produce books or documents, nor can they administer an oath, nor may any penalty be imposed on a person supplying them with false information. These powers were cut out by the House of Lords.

Part II. of the Act of 1917 is unaltered so far as Scotland is concerned—*i.e.* the existing law regarding minimum wages is made permanent, subject to the general provision already mentioned—and Part III. is in the same position.

In Part IV., however, there appears one of the vital changes introduced by the new Act. Section 9 of the earlier Act, dealing with the control of cultivation, is withdrawn and replaced by Section 4 of the new Act. The old Section 9 extended to three pages of print and Section 4 as approved by the House of Commons to seven pages, while Section 4 as finally passed extends to five pages. This gives a rough quantitative guide to the degree of control embodied in the various proposals. In this connection it must be remembered that Part IV. of the Act of 1917 has never been in force. As now modified, it came into force on 1st January 1921, but up to 31st December 1920 the control of cultivation by the State was exercised under the Defence of the Realm Regulations, modified only by the Corn Production (Amendment) Act, 1918, which gave aggrieved persons that recourse to arbitration which they would have had if Part IV. had been in force.

Section 4 thus embodies the permanent policy of the State (always subject to the provision for withdrawal) with regard to the control of the cultivation of land in the interests of food production. Subsection (1) gives the Board of Agriculture power to take action, after consultation with the Agricultural Executive Committee, with regard to any arable or grass land that is not being cultivated according to the rules of good husbandry (as defined in Section 33 (4)); or where the production of food can,

without injuriously affecting the persons interested in the land or altering the general character of the holding, be maintained or increased by the occupier by means of an improvement in the existing methods of cultivation; or where the tenant or owner has neglected to execute necessary works of maintenance (as defined in Subsection (9)).

The House of Lords cut out the power of compelling the arable cultivation of grass land, and inserted the phrase "altering the general character of the holding." They also secured the exclusion of land that is a "park, garden or pleasure ground or land adjoining a mansion house or garden attached thereto and required for their protection or amenity or woodland or land cultivated for osiers."

The Board's action is to be, as in Section 9 of the Act of 1917, by way of notice requiring compliance with their directions with regard to cultivation or maintenance, subject to the right of the person concerned to take the case to arbitration in accordance with Part IV. of the Act of 1917. With this must be read Section 5, which modifies the procedure in such arbitrations, as stated below. Unreasonable failure to comply is punishable with a fine of £20 and £1 a day for continuance of default after conviction (Subsection (4)). The Board may not interfere with the discretion of the occupier as to the crops to be grown. The indemnity proposed to be conferred upon a tenant breaking the conditions of his lease in consequence of the Board's action was cut out by the House of Lords; this is a logical result of the cutting-out of the power of compelling the arable cultivation of grass land and of the limitation on the Board's action just mentioned.

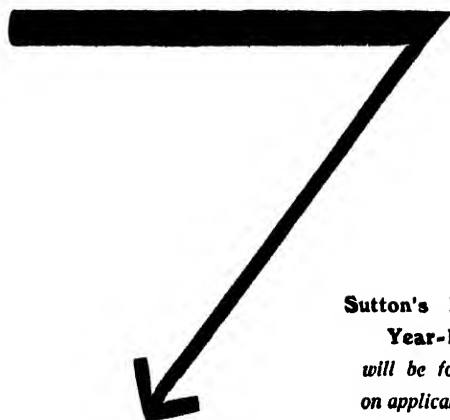
The Board are empowered to execute any work of maintenance and recover the cost from the person in default (Subsection (4b)), while in the case of a landlord's neglect they may authorise the tenant to do the work and recover the cost as if it were an improvement under the Act of 1908 (Subsection (5)).

With regard to prosecutions under this section of the Act, it may be worth while to point out that the exclusion of Scotland (see Section 34 (2)) from the operation of Subsection (4a), "proceedings for an offence under this subsection shall not be instituted except by the Minister," does not mean that in Scotland any other person or body than the Board of Agriculture for Scotland may take the steps necessary to have proceedings instituted; it merely conforms to the criminal law of Scotland, under which all prosecutions are instituted by the Crown.

The power proposed to be conferred upon the Board to determine the tenancy of a defaulting occupier, which they possessed under the Defence of the Realm Regulations and which was included in Section 9 of the Act of 1917, is excluded from the Act as finally passed.

The Board may, under Subsection (7) of Section 4, appoint a manager for an estate that is "grossly mismanaged to such an extent as to prejudice materially the production of food thereon or the welfare of those who are engaged in the cultivation of the estate." An order to this effect does not, however, take effect for six months, during which period the landlord may appeal to the

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Court of Session. Reservation is also made of mansion houses, gardens and parks, and of sporting rights that do not interfere with the production of food. The conditions under which the Board may exercise this power have been greatly restricted by the alterations made by the House of Lords.

Subsection (9) gives the definition of "necessary works of maintenance," already referred to in connection with Subsection (1).

Subsection (10) contains the highly important provision that when the Board are satisfied that injurious weeds (to be defined by Regulation) are growing on *any* land, they may require them to be destroyed under penalty, as in Subsection (4).

Section 5 is important from the point of view of procedure, especially in view of the recent decision in the Springkell case. It provides that if in any arbitration under Part IV. of the Act of 1917 the arbiter states a case, for the Sheriff's opinion on any question of law, an appeal will lie to the Court of Session, but no further except with leave of that Court.

Section 9 provides that Part IV. of the Act of 1917, as now amended, shall come into force on 1st January 1921. One result of this is that the Agricultural Executive Committees, which previously existed only in virtue of a scheme drawn up by the Board, became on that date statutory bodies. On the same date the powers possessed by the Board under the Defence of the Realm Regulations ceased.

PART II.—AMENDMENT OF THE AGRICULTURAL HOLDINGS ACTS.

Part II. of the Act is entitled "Amendment of the Agricultural Holdings Acts," and is intended to meet the complaints that have been made of the inadequate protection afforded by these Acts to agricultural tenants.

Section 10, which deals with compensation for disturbance, has been more drastically altered by the House of Lords than any other part of the Act. The compensation payable to a tenant who leaves his holding after 1st January 1921 by reason of a notice to quit given after 20th May 1920 is now limited to one year's rent (less the amount of certain rates and taxes, for which see Section 34 (3)), which is taken "for the avoidance of disputes" as representing the loss or expense directly attributable to the quitting of the holding and unavoidably incurred by the tenant, unless it is proved that the tenant's loss and expenses exceed that amount, in which case the amount may be increased up to a maximum of two years' rent (Subsection (6)). There is thus no provision in this Act for compensation for disturbance, apart from actual loss or expense, and no distinction is made between capricious and other refusal to renew a tenancy.

In Subsection (1) are given six reasons that disqualify a tenant for compensation. The paragraph requiring most attention is (a), "unless the tenant was not at the date of the notice cultivating the holding according to the rules of good husbandry," as defined in Section 33 (4). The other paragraphs are concerned with various defaults on the part of the tenant.

Subsection (2) provides that a landlord may at any time apply to the Agricultural Executive Committee for a certificate that a tenant is not cultivating according to the rules of good husbandry; landlord or tenant may within seven days after notification of the Committee's decision require the question to be referred to an arbiter, who must give his award within twenty-eight days after the matter is referred to him. In this connection Subsection (11) should be noted, which states that procedure in all arbitrations under Section 10 is to be in accordance with the Act of 1908.

Subsection (7) introduces another set of circumstances that preclude payment of compensation. Much discussion has taken place regarding paragraph (c), "where the tenant with whom the contract of tenancy was made has died within three months before the date of the notice to quit." The House of Lords proposed to change "three" to "six," but this was successfully resisted. Paragraph (d) brings in Section 23 of the English Act of 1908, which is applied to Scotland by Section 34 (9) of the present Act, with the necessary alterations. Paragraph (g) protects the interest of an owner-occupier desiring to resume the occupation of a holding let to a tenant, under specified conditions.

Subsection (12) as modified by Section 34 (4) excludes from the term "holding" any land "which forms part of any park, garden, or pleasure ground attached to and usually occupied with the mansion house, or any land adjoining the mansion house which is required for its protection or amenity, or any permanent grass park held for the purposes of a business or calling not primarily agricultural or pastoral, including that of butcher, cattle-dealer and the like," the compensation payable in respect of such land being that payable, if any, under Section 11 of the Act of 1908.

Subsection (3) provides that if a landlord refuses an arbitration on rent, and the tenant leaves his holding on that account, he shall be entitled to compensation for disturbance, under certain limiting conditions. Revision of rent cannot, however, take place less than five years from the beginning of the lease or the last change of rent (Subsection (4)). The House of Lords proposed to give the arbiter power to fix the period of renewal of tenancy under the revised rent, but this was not insisted on.

Section 11 provides for the payment to allotment-holders of compensation for disturbance based on "the benefits that would have accrued to the tenant" in a certain period.

Section 12, applying the provisions for compensation for disturbance to a cottage occupied by a worker on a holding, is rendered practically inoperative in Scotland by the proviso (Subsection (1c)) that it does not apply where the worker is employed for a year or half-year, and the occupation is terminated at the end of such period.

Section 13 does not apply to Scotland, but corresponding provision is made in Section 34 (7) for the alteration of Section 18 (1) of the Act of 1908, so that notice of not less than one year is now required in the case of leases of two years and upwards (instead of three).

Section 15 amends the law as to improvements, providing that in certain circumstances an Agricultural Executive Committee

may direct that an improvement under Part I. of the First Schedule to the Act of 1908 may be treated as if it were in Part II. of that Schedule. The improvements that may be so treated are to be defined by Regulations made by the Board. Subsection (3) contains elaborate provisions regarding market gardens. There is recourse in all cases under this section to arbitration in accordance with the Act of 1908.

Section 16 enacts that a tenant quitting a holding shall receive compensation for increased value to an incoming tenant due to "the continuous adoption of a standard or system of farming that has been more beneficial to the holding than the standard or system, if any, required by the contract of tenancy," provided that a record of the condition of the holding has been made. Arbitration is as usual to be in accordance with the Act of 1908, and the arbiter is directed to take into consideration any separate compensation that the tenant may receive for improvements that have contributed to the increased value.

Section 19 provides for compensation to a landlord for deterioration of a holding during tenancy.

Section 20 enables the Board to make rules with the object of expediting arbitrations and reducing their cost.

Section 21 provides that where the Board nominate an arbiter under the Second Schedule to the Act of 1908 it shall be from a panel drawn up by the Lord President of the Court of Session. The remuneration of an arbiter so appointed is to be fixed by the Board, while the remuneration of an arbiter appointed by agreement is to be fixed, failing agreement between him and the parties, by the Sheriff.

PART III.—GENERAL.

Reference has already been made to the definition of the expression "rules of good husbandry" that is given in Section 33 (4). This is a matter of fundamental importance as affecting the Board's powers under Section 4 (1a) and the tenant's right to compensation under Section 10 (1a). The definition extends to nearly a page of print, and was described by Sir Arthur Boscawen as "the longest definition of the rules of good husbandry ever known in the history of agriculture." Its terms were discussed up to the last moment. In particular, the Lords wished to alter the phrase "clean and in a good state of cultivation, condition and fertility" to "a high state," but this was successfully resisted.

Most of the material points in the application of the Act to Scotland (Section 34) have already been mentioned, but reference should be made to a proposal that failed. The Government's intention was that all arbitrations under this Act or under lease should, failing agreement as to an arbiter, be determined by the Scottish Land Court. This was rejected by the House of Lords, and even the proposal that voluntary recourse to that Court should be allowed failed to pass.

Some minor points in Part III. may be briefly mentioned. Section 31 enables Agricultural Executive Committees to delegate their powers to sub-committees. Section 32 puts an agricultural

employer in the position of landlord of a house provided for his employee as part of his remuneration, for the purposes of Sections 14 and 15 of the Housing Act, 1909, but does not affect the obligation of any person other than the employer to repair such a house. The additions made in the First Schedule to the list of improvements in the First Schedule to the Act of 1908 should also be noted.

WART DISEASE OF POTATOES.

RESULTS OF IMMUNITY TRIALS IN 1920.

IN 1919 the Board of Agriculture for Scotland acquired two plots of land, one at Avenue Park, Philpstoun, West Lothian, and the other at Duddingston, Edinburgh, for the purpose of carrying out extensive trials of immunity from wart disease of potato varieties, similar to the trials conducted by the Ministry of Agriculture and Fisheries at Ormskirk.

The success that has attended the English trials and the great development they have brought about in the business of potato breeding are well known. This development is as yet only in its early stages; the extent of the spread of wart disease has only lately been realised, but the realisation has brought with it the unavoidable conclusion that the threatened peril to the potato industry of this country is to be averted only by the complete and adequate substitution of approved varieties for the standard non-immune varieties which at present occupy the premier place in the ware market, and by the maintenance of pure stocks of those immune varieties which have proved acceptable to the farming and to the consuming community.

The Board have made arrangements for establishing in 1921 a Registration Station for testing, recording, and certifying new varieties of agricultural plants, including potatoes, and, in so far as this scheme applies to potatoes, the immunity trials will become part of the work of the Registration Station.

It is intended that the work of registering and disease testing shall be as complete as possible, and ultimate developments will be directed towards—

- (1) The registration of new varieties;
- (2) The testing of varieties for immunity from wart disease;
- (3) The testing of varieties for resistance to other diseases, notably blight;
- (4) The testing of varieties for quality and yield.

The inspection of stocks of immune varieties and the certification of such stocks as are pure will also be maintained. Raisers of new varieties will be afforded an opportunity of eliminating, at an early stage, seedlings which are of no marketable value on account of non-immunity, and will be enabled to concentrate on comparative trials of the immune types. By the aid of this work breeders of new varieties should be able, in the no distant future, to supply growers with varieties which are wart-free, blight-resistant, vigorous, high-yielding, and of good marketable quality,

and when such varieties come into general cultivation the danger of wart disease will have disappeared.

Results of Trials, 1920.—The trials in 1919 were inconclusive, as the season, in which no rain fell on the ground from the time of planting to the middle of September, was adverse.

In 1920 the season was very favourable for a test, and care was taken to ensure that each variety tested was subjected to the effects of the disease, direct infection of the soil in proximity to the seed tubers being made at the time of planting. This year a total of two hundred and ten samples were submitted for testing, excluding eighty forwarded by the United States Department of Agriculture. In addition one hundred and sixteen samples of susceptible and immune varieties were interspersed among the plots for purposes of control and comparison. One hundred and six of the varieties sent in for trial have so far shown no sign of being affected with wart disease, leaving one hundred and four on which wart disease has been identified. Fifty-four of the varieties apparently immune and forty of those susceptible to wart disease appear to be new and distinct, the remainder belonging to standard types. A certificate of immunity from wart disease will not be granted for any variety unless it survives a test for two successive years at least, as a single year's test cannot be considered conclusive, particularly in the case of early varieties. Of the varieties which proved susceptible this year, those which appear to be new and distinct will be subjected to a further year's test, while those obviously belonging to a standard non-immune type have been discarded.

Arrangement of Tests.—The varieties to be included in the tests are first sprouted in boxes. At this stage the colour of the sprout of the sample is noted, and tubers which have sprouts differing in colour from the bulk of the sample are removed. During the growing season, observations are made on the characteristics of the varieties under test, and all plants which are obviously not true to type in any sample are removed. Notes are also taken on the occurrence of other diseases than wart disease, notably blight, corky scab and mosaic. It has been found that in the case of varieties submitted for test a considerable number of the samples are not pure, and it is suggested that persons who desire to have varieties tested in future should mark one or more plants of the true type during the growing season, and select the sample for test from the produce of these marked plants. Six tubers of each variety are planted at both centres. In the first year of trial, the varieties are arranged in plots so that all those from one sender are together, but in the second year the varieties are arranged according to the following plan:—

(1) Time of maturity; (2) colour of skin; (3) colour of sprouts; (4) shape of tuber; (5) colour of flesh; (6) colour of flower; (7) characteristics of haulm.

This arrangement ensures that similar varieties are placed together, and at the same time facilitates demonstration and comparison.

The possibility of proving the susceptibility of an individual plant from any crop by transfer of the plant to the trial ground was tested during the season. A typical plant from a crop of an unknown variety grown in a clean field in Stirlingshire was transferred to the testing ground at the beginning of August and planted in soil infected with fresh green wart. The plant died down in about three weeks' time. Warts were found on the last developed tubers when the plant was lifted in October.

Types.—Varieties are said to belong to a standard type when they are indistinguishable in their botanical characters from that established type. Undoubtedly many so-called new varieties are simply selections from an established standard variety, but the possibility of the reconstitution of a standard variety in a new seedling, whether produced by artificial cross-fertilisation or natural self-fertilisation is not left out of consideration.

The origin of new varieties in any other way than from the seed of the plum has not been proved absolutely in any one case. The only accepted authentic instances of sporting are changes in the colour of skin of the tubers, which differences alone are not regarded as constituting a new variety.

The following is a list of some of the varieties tested. The list includes standard varieties used for comparison and control, as well as varieties on which definite reports on immunity or susceptibility have been issued. Varieties identical with standard types, but submitted for test under a name other than the recognised name of the variety to which they pertain, are indicated in italics and classed with the variety they resemble.

Varieties Immune from Wart Disease.

1ST EARLIES.

America, Witchhill (*Glencagles Early*, one sample unnamed), Snowdrop, Dargill Early, Sutton's A1, Early Pink Champion, (*Fifeshire Early Champion*), Arran Rose.

2ND EARLIES.

Entente Cordiale, Katie Glover, Arran Comrade, Conquest. (*Duchess*), Nithsdale, Schoolmaster, King George V., Edzell Blue, Rule Britannia, Mauve Queen, Mr. Bresse, Towser.

EARLY MAINCROP.

Abundance (*Jeannie Deans*, *Culdees Castle*, *Kerr's New White*, *Crowner*, *Secundus*, *Admiral*, *Provost*, *Laing's Prolific*, *Plotholder*, *Darlington*, *Colossal Beauty*, *Carrick Queen*, three samples unnamed), Great Scott, (*Southampton Wonder*, *Hunter's Invincible*), Burnhouse Beauty, Ally, Red-eyed Rogue of Ally, Early Market, Marvel of Variation, K. of K., Majestic, Crusader, Catriona.

LATE MAINCROP.

Champion, Champion II. (*Clifden Seedling*), Carnegie (*Roeallan*, *White City*), Bishop, Lochar, Tinwald Perfection, Templar, Langworthy (one sample unnamed), Golden Wonder (*Peacemaker*), Irish Chieftain, Dominion, Dean, Kerr's Pink, Flourball, Shamrock, Irish Queen, Rector, Ranfurly Red, Arran Victory, Pink Seedling.

Susceptible Varieties.**1ST EARLIES.**

Epicure (*Fullsack*), Harbinger (*Pierrimont Seedling, Tweedside Early*), Ringleader, Eclipse (*Early Seed, Sir John Llewellyn*), Sharpe's Express, Early Rose, St. Andrew, Duke of York (two samples unnamed), Midsummer Early (*The Macs*), Sharpe's Victor, Dunottar Castle, Myatt's Ashleaf, May Queen, Eightyfold, Ruby Gem.

2ND EARLIES.

M'Cawley's Pink Eye, Mein's Early Round, British Queen, (*Golden City, English Beauty, Scottish Standard, Robson Seedling, Pioneer, Duncraig Castle, Tam o' Shanter, Marvel, Snow Queen*, two samples unnamed), Snowflake, Royal Kidney, Brydon's Blue Cross.

EARLY MAINCROP.

Bantam, Thane o' Glamis, Langholm Model, Magnificent, Carrick Abundance, Evergood (*El-Dorado*), John Bull, Lord Rosebery, Triumphs, Kirrie Reds, Chelmsford, Herd Laddie, King Rufus, King Edward VII. (*Red King Edward, Macgregor, Rob Roy*, two samples unnamed), Purple Eye No. 2.

LATE MAINCROP.

Northern Star (*Ajax*), Cumberland Ideal, Field Marshal, (*Strathore*, one sample unnamed), Up-to-Date, (*Dreadnoughts, Date Variety, Dobbie's Prolific, Scottish Triumph, Dalhousie, Duchess of Cornwall, Factor, Lovat's Seedling, Crossford Beauty, Britain's Glory, Great Gift, Mairsland Don, New King, Redhead, Bonnie Don, Blair's Best, Islay Perfection, Drumwhindle Seedling*, two samples unnamed), President, (*Mein's Perfection, Scottish Farmer, Iron Duke, Champion of Hampshire*), Arran Chief, (*Isla*, three samples unnamed), Summit (one sample unnamed) Den o' Airlie, Thrums, Angus, FitzJames, Professor, Banff Castle, Ewine Pink, Blue-Don, Fortyfold (*Piebald*).

American Varieties.—Of the eighty American varieties included in the Trials, fifty-five were named sorts and twenty-five unnamed hybrid seedlings. Only four of the varieties showed any promise: these were of the up-to-date type and non-immune. The early sorts died down very early and yielded only a very small crop; maincrop types also died down early and seemed to be lacking in vigour and weak in the haulm. Features of the majority of the named varieties were the number and depth of eyes on the tubers. Fifty-two of the varieties were susceptible to wart disease, and eight were doubtfully susceptible. Most of them were extremely subject to blight. The varieties which are apparently immune to wart disease do not show any promise of being suited to field culture in this climate.

Observations on New Immune Varieties which were Outstanding in the Trials.—*Katie Glover (Findlay)*.—This is a very promising 2nd-early variety. The tuber is red in the eye and about the eyes at the point of the tuber; elsewhere the skin is yellow. The eyes are shallow. The flesh is white and firm. The haulm is spreading, and the leaflets are light-green-coloured and very broad. Leaf veins are very distinct.

Red-eyed Rogue in Ally.—This variety yields a very heavy crop, but the tubers, which resemble those of Lochar, are somewhat coarse and often hollow. The cooking quality is not very good. The crop showed a considerable number of tubers affected by blight. The haulm is spreading and vigorous, the leaflets large, dark green and glossy. The flower is white, but infrequent.

K. of K. (Findlay).—An early maincrop variety which under suitable conditions gives a large crop of beautiful oval tubers which have a yellow skin blotched carmine about the eyes. There are three selections—No. 1, No. 2, No. 3—according to the amount of colour present on the skin, but the selections do not remain true to colour. The flesh is white, tinged lemon. The cooking quality is very good. The tubers are somewhat soft. The haulm consists of a number of tall slender stems which have a tinge of pink. The leaflets are small and dull. The flower is mauve, but not freely produced.

Crusader (Wilson).—This variety was tested under the Reference No. 339.3. It cropped very well in the trials. The tubers are kidney-shaped. The eyes are shallow and open, and are generally on the shoulder of the potato. The haulm is vigorous, upright and compact. The leaves have a dark glossy crinkled appearance.

Nithsdale (McAlister).—This variety ripened early enough to be classed as a 2nd-early, and produced a large crop of handsome kidney tubers. The cooking quality is very good. This variety differs from Majestic in its rather earlier maturity, its bright foliage, the colour of the sprouts of its tubers, and in its less abundant blooms and absence of plums.

Irish Chieftain.—The foliage of this variety is like that of Northern Star, and is subject to mosaic disease, but the bloom is violet-purple and profuse. It is of very late maturity and is practically untouched by blight. The tubers are somewhat coarse and throw considerable second growth. The variety cropped very well in the trials.

A complete descriptive and classified list of varieties tested will be supplied on application to the Secretary.

THE following extracts are taken from a paper on this subject, read at the Forty-Sixth Annual Congress of the Incorporated

Sanitary Association of Scotland by Mr.

Grading and Arthur Gofton, F.R.C.V.S., Chief Veterinary

Definition of Milk. Inspector of the City of Edinburgh. Mr.

Gofton sees various indications that the early introduction of an official system of grading is seriously contemplated by the central health authorities and makes the following observations on the subject:—

“It would appear reasonable to suppose that the official grading of milk, if definitely decided upon, would be a matter rather of growth and development than of immediate general application. The official certification of the higher and better qualities, which are likely always to constitute a relatively small proportion of the total supplies, would be undertaken in the first

instance, and when sufficient experience had accumulated the principle could be extended gradually to the other classes, provided the value of the results achieved justified the cost of securing them. Under any circumstances, it would not be possible to make any system of grading which might be devised generally operative immediately after its introduction—a lapse of time would be essential during which the information necessary to permit the grouping of milk into the different categories could be accumulated. A single test would not be a fair criterion of the average qualities of milk derived from any source, and would neither justify inclusion in a particular category nor exclusion from it. A fair and just estimate could only be formed by a series of tests spread over a period of time. Nor could any system of grading guarantee that a particular milk would conform at all times to a definitely specified standard. Only by check tests repeated at relatively short intervals would it be possible to obtain a degree of assurance that the requisite standard was being maintained.

“Milk may be graded on the basis of (*a*) chemical composition, (*b*) hygienic qualities, or (*c*) a combination of (*a*) and (*b*). A combination of the chemical and hygienic standards would constitute the only sound procedure. The official grading of milk could only justify itself provided it proceeded along lines calculated to gain the confidence of the consumer by conveying an assurance that the milk purchased was in a sound, wholesome condition, and possessed not less than a minimum nutrient value as measured by a fixed chemical standard. It would require also to provide a constant stimulus to the producer to aim at maintaining and improving the quality of his produce by excluding from classification milk which did not conform to minimum standards both nutrient and hygienic, and by conferring on him the right to demand a higher price which bore a distinct relationship to the standard of quality which he succeeded in attaining.”

“If the official grading of milk is to be undertaken, it is essential to realise the importance of grading on this double basis, no matter whether the principle is to be applied generally or only to a limited extent. The need for improvement in the hygienic quality of milk is admitted, and it is being strongly impressed on the public, but too little attention is being directed to food values. There is thus more than a possibility that the importance of the latter may be obscured by the prominence given to the former. Efforts to improve the hygienic and nutrient properties of milk ought to proceed hand in hand. If grading is to serve a really useful function, and is to justify the cost of its application, the scheme must be well balanced and have for its object an all-round and not one-sided improvement.

“The fat content of milk provides the simplest means of arriving at a measure of the nutrient properties of milk, and in grading on a basis of chemical composition the percentage of butter fat must constitute the standard. It is eminently desirable that a minimum legal standard for milk should be set up, which should be the present presumptive British standard of 3 per cent. fat, 8.5 per cent. solids not fat.”

“A butter fat standard is demanded of all milk in certain of the

British Colonies which is higher than the presumptive British standard. Tasmania and Victoria demand 3·5 per cent. of butter fat; Canada, West Australia, and New Zealand, 3·35 per cent. In thirty-six States in the United States of America the standard demanded in two is 2·5 per cent., in eighteen 3·0 per cent., in eleven 3·25 per cent., in four 3·5 per cent., and in one 4·0 per cent. The American Association of Medical Milk Commissions lays down a 4 per cent. fat standard for certified milk, with a permissible range of 3·5 per cent. to 4·5 per cent., the fat standard to be determined at least once each month. Great Britain has always claimed pre-eminence for the quality of her live stock, but if we are obliged to plead inability to attain a lower standard than has been found practicable in other countries, it must at once be admitted that, so far as our dairy stock is concerned, the pre-eminence claimed rests on an unsound basis."

"The quality must be based on an average of a series of tests. In Scotland, at least, a great deal of the information on which grading on a basis of butter fat content might proceed has already been accumulated by the Scottish Milk Record Societies. It should be possible to arrange for the records of societies to be made available for the purposes of an official scheme of grading, and the possibility of employing their machinery should be worth considering as contributing to economical working. It could not replace official tests carried out by a grading authority, but ought to be a most useful complement to them."

"The fundamental weakness of a bacteriological standard lies in the necessity of basing it almost wholly on numbers of bacteria irrespective of kinds, but used in conjunction with supervision by inspectors bacteriological standards are of material value in providing a test of the efficiency and adequacy of the work of inspection."

"In the application of bacterial standards to the grading of milk the choice lies between the numbers and the kinds of bacteria present. The tendency to follow the lead of the United States, and to attach to numbers an importance greater than rightly belongs to them, is very pronounced.

"It is not contended that numbers do not possess a significance from the public health and from the economic points of view. Heavy bacterial contamination indicates carelessness in collection and handling, and indifference to the fact of contamination cannot be differentiated from indifference to the nature of the contamination. In other words, dirty milk containing large numbers of bacteria is more likely to contain pathogenic organisms than milk in the collection of which careful supervision is exercised. Large numbers of bacteria also indicate that deterioration and souring have already commenced, or will take place rapidly; they are evidence that the qualities of soundness and freshness have been impaired."

"Assuming numerical bacterial standards were to be used for the purposes of grading milk, it would be necessary as a preliminary procedure to standardise the methods of examination in every detail. Bacterial counts do not claim to be more than estimates of the numbers of bacteria in milk, and without standard-

isation of methods it would be impossible to obtain results which would be even approximately comparable. The cost of applying numerical bacterial standards in any general system of grading milk would be heavy and would constitute a material objection to their adoption. The force of this objection would be strengthened by the fact that the value of the information gained would not be proportionate to the cost of securing it. Numerical standards are fundamentally defective, inasmuch as they consider numbers only and take no account of kinds. In this respect they constitute an unsound guide to the quality of milk, a few pathogenic bacteria being capable of infinitely more harm than millions of the saprophytic organisms which always constitute the majority of the bacteria found in milk. Numerical bacterial standards have a most useful place in administrative work, but it would be difficult to justify their inclusion as a fundamental part of a general system of grading milk.

"If it were possible to determine the different kinds of bacteria present in milk by a simple and rapid procedure, valuable information for the purpose of classifying milk would be available, but, unfortunately, the means of accurate and rapid differentiation do not exist.

"The bacillus of tuberculosis is an exception to this general rule, and it is by far the most important and the most common of the pathogenic organisms found in milk. The tuberculin test provides the means whereby an assurance can be obtained that this dangerous micro-organism will not be present in milk from a particular source. It also provides a valuable means whereby milk may be graded definitely and simply into two main classes—milk from tubercle-free herds and milk from non-tested herds.

"It is impossible to leave this subject without reference to the commercial pasteurisation of milk so extensively used in large towns. Commercial pasteurisation consists for the most part in heating milk to a temperature of 140 deg. Fahr. to 150 deg. Fahr., and immediately cooling it. Objection may rightly be urged against the sale of this milk without disclosing the fact that it has been heated, but the heating process has a very material value, and much more may be advanced in its favour than against it. The term pasteurisation ought, however, to be defined and limited to a process which will render the tubercle bacillus innocuous, since in its capacity for harm it occupies a place of paramount importance, and it is one of the most resistant organisms found in milk. It cannot be claimed that the ordinary 'flash' commercial pasteurisation will accomplish this object. The evidence shows that a temperature of 145 deg. Fahr. continuously held throughout the volume of milk for a period of thirty minutes or of 175 deg. Fahr. for thirty seconds can be depended upon to render the tubercle bacillus harmless. The commercial pasteurisation of milk by the 'flash' process as well as by the more efficient 'holding' process should receive official recognition and be permissible in respect of graded milk provided that the milk so treated was not sold as raw milk."

THE following facts and figures are taken from an article in *The Farmer's Advocate and Home Journal*, by Mr W. H. Clark, U.S.A., of the Ontario Agricultural College:—The

Cost of Milk Production.

need of authoritative and accurate information as to the costs of production generally, and the possibilities of more economical production, had long been felt in Ontario, but it was not till the spring of 1917 that funds were made available for the investigation of this problem. In the autumn of that year a small survey was made, when about one hundred and twenty-five farmers were visited, and particulars were obtained from them regarding the following points:—

- (1) Size of farm, acres tillable, and acres in different crops.
- (2) Yield of various crops and receipts from sales of crops.
- (3) Numbers and values of all live stock handled, bought, or sold during the year.
- (4) Sale of milk and other live stock products.
- (5) Purchases of feed and seeds of different kinds.
- (6) All other current expenses in detail, such as labour, repairs, taxes, threshing, veterinary.
- (7) Numbers, values, and probable life of all farm equipment.
- (8) Actual value of farm, and value and expected life of all farm buildings.

Following the completion of the field work the report of each man's business was worked out to determine the returns of his year's work: his labour income, which is the amount of money that the farmer has left after deducting running expenses of the farm, including the value of the labour of unpaid members of the family who work for no stated wages, allowing for depreciation on buildings and machinery and interest on investment.

The work has since been extended, and the facts obtained have been tabulated and co-ordinated.

In the case of the dairy-farming business it was found that the quality of live stock—*i.e.* the producing capacity of the milch cow—is the greatest single factor in determining the profit or loss.

GOOD LIVE STOCK AND LABOUR INCOME.

Quality of Live Stock.		No. of Farms	Labour Income.	Feed Bought.	Labour Hired per Farm.
Under	71 per cent. of average ...	35	\$14	\$206	\$425
	71 " " — 80 per cent.	34	761	140	354
	81 " " — 90 " "	48	948	231	425
	91 " " — 100 " "	61	1310	233	446
	101 " " — 110 " "	51	1498	266	417
	111 " " — 120 " "	32	1610	296	368
	121 " " — 130 " "	27	1872	338	549
Over	130 " " of average ...	40	2047	422	433

The above table was prepared from information gathered in the Oxford County Survey, covering the farm year 1st March 1918 to 1st March 1919. It will be noticed that the labour income

shows a steady increase as the quality of live stock improves. More feed was required for the more highly productive stock, as shown by the "feed bought" column, but it was more than repaid.

As was natural to expect, crop yields had a considerable bearing on ultimate profits. It costs very little more to handle a good crop of a given acreage than a poor one. It is quite apparent that the first logical step towards increasing farm profits is by improved cultural methods and thereby increased crop yields per acre.

It was seen that both good crops and good stock exert an influence on farm returns. The following table was prepared to determine which of these influences was the greater:—

COMPARATIVE EFFECTS OF GOOD CROPS AND GOOD LIVE STOCK ON AMOUNT OF LABOUR INCOME.

Farms with	Poor Live Stock.	Medium Live Stock.	Good Live Stock.
Poor Crops {	No. of farms—39 Labour Income —\$449	No. of farms—36 Labour Income —\$1335	No. of farms—20 Labour Income —\$1398
Medium Crops {	No. of farms—68 Labour Income —\$674	No. of farms—50 Labour Income —\$1398	No. of farms—54 Labour Income —\$1900
Good Crops {	No. of farms—20 Labour Income —\$786	No. of farms—26 Labour Income —\$1473	No. of farms—25 Labour Income —\$2134

On making comparisons it will be noted that the increase due to improved live stock is very much greater than that due to increased crop yields. From poor crops and poor stock to good crops and poor stock, \$337; from poor crops and poor stock to poor crops and good stock, \$949.

Thus it is plain to be seen that the man with the good stock is in a much better position to withstand a total or partial crop failure. His stock will make much better use of high-priced feeds.

The Department was able to demonstrate in dollars and cents the effects of the good pure-bred sire in dairy herds. As every dairyman knows, the first step in grading up a herd is the use of a good pure-bred bull from a high-producing dairy strain. The following table shows the ultimate result of improvement of breeding. The profit over feed from the highly graded herd is three times as great as that in the herds headed by the grade or scrub sires; while the farm returns are almost twice as great. The same amount of labour and very nearly as much feed was required for the poor quality herds as for the graded-up herds, but the net profits were much lower.

THE PURE-BRED HERD SIRE.

	No. of Farms.	Labour Income.	Milk sold per Cow.	Feed per Cow.	Profit over Feed.
Grade Sire	131	\$961	\$94	\$76	\$18
Pure-Bred Sire, 5 years or less	49	1248	117	81	36
Pure Bred Sire, 5-10 years	46	1473	115	81	34
Pure-Bred Sire, over 10 years	74	1710	137	86	51

A study was made of some of the main factors in the farm business which tended toward the lowering of the cost of production and hence increasing the farm profits.

Undoubtedly the factor which had the greatest effect was high milk yield per cow—*e.g.* there were twenty-seven farms where the herd average was less than 400 lbs. On these farms the average cost of production was \$3.96 per cwt. On the other hand, there were eleven farms where the herd average was over 7000 lbs. These men were able to produce milk at an average cost of \$2.05 per cwt.

Having found the greatest factor in reducing cost of production the next logical question was "How best can milk yield be increased, by feeding or by breeding?" The following table was prepared to discover the relative effects of the cost of production of increased production by feeding and by breeding:—

BREEDING *v.* FEEDING TO INCREASE MILK YIELD PER COW.

Farms with	All-Grade Breeding or Pure-Bred Sire less than 5 years	Pure-Bred Sire More than 5 years
Feeding low (below \$86 per cow)	No. of farms ... 45 Herd Average lbs. 4400 Cost per Cwt. ... \$3.08	No. of farms ... 31 Herd average lbs. 5400 Cost per cwt. ... \$2.03
Feeding high (above \$86 per cow)	No. of farms ... 30 Herd Average lbs. 5400 Cost per Cwt. ... \$3.00	No. of farms ... 33 Herd average lbs. 6100 Cost per cwt. ... \$2.28

The above table shows both methods of increasing herd production of milk. The upper left-hand group were both poor feeders and poor breeders. Consequently their herd average was 4400 lbs. and their average cost of production was \$3.08. The lower left-hand group were poorly bred but were liberal feeders. By feeding alone they were able to raise their herd average to 5400 lbs. and reduce their cost of production to \$3.00 per cwt. The upper right-hand group used the other method to increase milk yields. They were sparing feeders, but each man had used a pure-bred sire to head

his herd for over five years. In consequence, their herd average was also 5400 lbs. per cow, but their cost of production was only \$2.03 per cwt. The breeding method is slower in bringing results but can be carried on in conjunction with the feeding method. Going further and looking at the lower right-hand group, it is seen that the herd average has been raised to 6100 lbs. by liberal feeding, but the cost per cwt. has also been raised twenty-five cents per cwt. over the group above.

AT the November meeting of the Royal Society of Edinburgh a joint communication was made by Dr. J. Rennie, Miss Elsie J.

**Isle of Wight Bee
Disease.**

Harvey and Mr. P. Bruce White, on the results of their investigations into the cause of Isle of Wight Bee Disease. The investigations have reached an important stage, for the authors believe that the discovery of a minute mite which occurs in the air-tube of the thorax solves the problem of the disease. They discussed the appearance of the mite, the particular positions to which it is confined in the bee, the symptoms caused by its presence, and experiments to discover by what means mites passed from one bee to another. The effect of the presence of the mite seems to be due partly to toxic conditions to which it gives rise, but mainly to a mechanical blocking of the respiratory apparatus, with a resultant cutting off of the supply of oxygen from certain nerve centres and muscles concerned with locomotion. The publication of the investigators' paper will be awaited with expectancy, but a first impression is that they have made out a good case for their claim to have discovered the cause of "Isle of Wight."

DURING the summer of 1920, at the request of Col. Behrens, R.E., an experiment was undertaken at the Board's Seed Testing

**Germination of Seed
of Phormium Tenax.**

Station, having as its object the determination of the optimum conditions of testing, so far as the standard available apparatus for making germination tests permitted, the germination of seed saved from plants of Phormium tenax (New Zealand Flax) grown in Scotland. Five samples were provided by Col. Behrens, and the results of tests on one sample are given in the following table. Similar results were obtained from tests of other three samples, but in the case of the fifth sample, the seed, which was year-old, failed to germinate under any conditions.

It will be seen from the following statement (p. 80) that the seed of this species is slow to germinate and possibly retains the capacity for germination for one year only: that the standard method most applicable to a test of this seed is the same as that used in testing the germinating capacity of the Chenopodiaceæ—viz. the seeds are pressed lightly into damp sand and incubated at a temperature of 20° C. for eighteen hours, alternating with a temperature of 30° C. for six hours.

GERMINATION TEST.

Name of Seed.	Method of Germination.	Temperature.	% germ. in 30 days.	% germ. in 60 days.	% germ. in 112 days.
Phormium tenax A.	Absorbent paper circles in Hearson Germinator in light.	20°-30° C.	4	32	46
	Sand Tray at window.	Indoor temp. variable.	0	0	4
	Between folds of ab- sorbent paper in Incubator in dark- ness.	22° C.	0	0	0
	Sand Tray in Hearson Germin- ator in light. ...	20°-30° C.	52	64	66
	Sand Tray in Hearson Germin- ator in light. ..	20°-30° C	29	61	73

THE Abstract of the Agricultural Returns printed at pp. 113-120 shows that the total area under all crops and grass amounts to

**Agricultural
Returns
for Scotland, 1920.**

4,739,046 acres, a decrease of 12,429 acres as compared with 1919, the arable land having decreased by 28,242 acres, while the area under permanent grass is greater by 15,813 acres. The land under rye-grass and other rotation grasses and clover has increased by 34,696 acres; the decrease in the area under other crops is thus 62,938 acres. The area under wheat is less by 25,150 acres, or 31.63 per cent., that under barley is greater by 30,623 acres, or 17.63 per cent., while that under oats has decreased by 78,613 acres, or 7.08 per cent. The total area under the cereal crops is 1,300,004 acres, or 71,290 acres less than last year. Beans show a decrease of 928 acres or 13.95 per cent. Potatoes have increased by 7881 acres, or 5.10 per cent., while turnips and swedes have decreased by 1196 acres, or 0.28 per cent. The area under flax has increased by 63.64 per cent., the acreage being 1638 as compared with 1001 last year. Rape shows a substantial increase, while the acreage under vetches, tares, etc., for fodder is lower by 1141 acres. Of the other crops, peas, vetches or tares for seed, and small fruit have increased while mangolds, cabbage, carrots and onions have decreased. The increase in the area under rotation grasses and clover is 34,696 acres, or 2.47 per cent., the area for hay being greater by 31,010 acres, and that for pasture by 3686 acres. Permanent grass shows an increase of 15,813 acres or 1.18 per cent., the area for hay being greater by 4485 acres, and that for pasture by 11,328 acres. The total area cut for hay was 577,420 acres, or 35,495 acres more than last year.

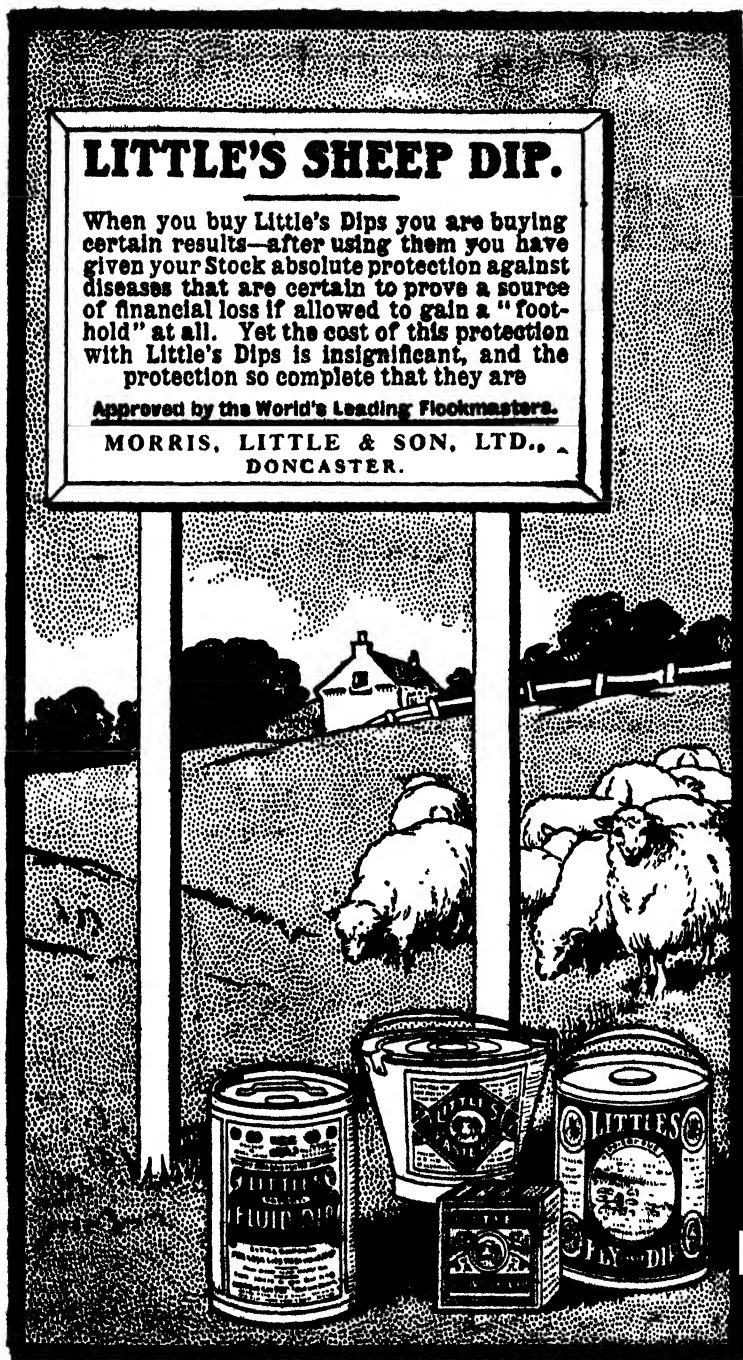
The area under wheat, barley, oats and potatoes this year is, in

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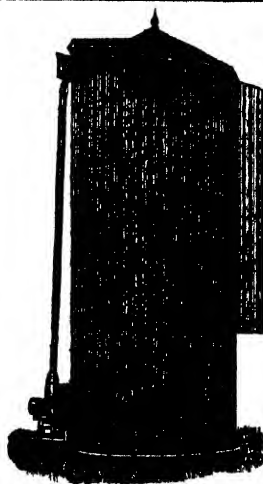
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1921] ANNUAL ESTIMATES OF THE PRODUCE OF CROPS.

round figures, 1,453,000 acres; this is 65,000 acres less than last year, but 100,000 acres more than in 1916, which was the basal year for the food production campaign.

The live-stock returns show that the number of horses has increased during the year, but cattle, sheep and pigs have all decreased to a considerable extent. Horses used for agricultural purposes are fewer by 2366, and "other horses" by 221, while unbroken horses have increased by 3593, the net increase thus amounting to 1,006, or 0·47 per cent. Cows in milk have decreased by 11,981, or 3·31 per cent., cows in calf by 6812, or 15·15 per cent., and heifers in calf by 2353, or 4·84 per cent. The total number of breeding and milking cattle has thus decreased by 21,146. Bulls used for service are fewer by 1389, or 7·27 per cent. Other cattle of two years and above have decreased by 1297, or 0·57 per cent. while those of one year and under two, and those under one year are fewer by 14,041, or 4·96 per cent., and 26,052, or 10·76 per cent. respectively. The whole number of cattle has thus decreased by 63,925, or 5·20 per cent. Breeding ewes are fewer by 69,699, or 2·47 per cent., rams by 2241, or 2·82 per cent., and other sheep of one year and above by 54,091, or 5·07 per cent., while lambs are more numerous by 76,920, or 3·16 per cent. Sheep, as a whole, are thus fewer by 49,111, or 0·77 per cent., the total being the lowest since the Returns were first collected over fifty years ago. Sows kept for breeding have decreased by 504, or 3·34 per cent., boars used for service by 67, or 4·01 per cent., and other pigs by 8775, or 7·24 per cent., the total decrease amounting to 9346 or 6·78 per cent.

Annual Estimates of the Produce of Crops. The following statement regarding the produce of crops for 1920 was issued on 9th December:—

The sowing of wheat was carried out under considerable difficulties, as, although the harvest of 1919 was earlier than usual, the weather conditions at the end of the year were very unfavourable and little could be done after the beginning of November. As is well known, the proportion of spring-sown wheat in Scotland is very small. The sowing of barley and oats was also retarded owing to wet weather in March. All the grain crops matured slowly owing to lack of sunshine and warmth, and, in addition, the wheat crop suffered extensively from an attack of the wheat bulb fly in April and May. Harvest, generally, was later than usual, and operations were more or less protracted owing to unfavourable weather. The quality both of grain and straw is below the normal in many districts, more especially in the case of late-sown fields. The hay harvest was also late and protracted, and some damage and loss was caused by rain and floods.

The planting of potatoes and the sowing of roots were also somewhat later than usual owing to unfavourable weather and the wet condition of the ground. Potatoes and turnips have proved good crops generally, and disease has not been prevalent to any

Preliminary Statement showing the ESTIMATED TOTAL PRODUCE and YIELD PER ACRE of Wheat, Barley, Oats, Beans, Hay, Potatoes and Roots in Scotland in the Year 1920, with COMPARISONS for 1919, and the AVERAGE YIELD PER ACRE of the Ten Years 1910-1919.

Crops.	Estimated Total Produce.		Acreage.		Average Estimated Yield per Acre		Average of the Ten Years 1910-1919.
	1920.	1919.	1920.	1919.	1920	1919	
	<i>Quarters.</i>	<i>Quarters</i>	<i>Acres.</i>	<i>Acres</i>	<i>Bushels</i>	<i>Bushels</i>	<i>Bushels.</i>
Wheat	260,000	383,000	54,359	79,509	38'2	38'5	39'5
Barley (including Bere)	973,000	764,000	204,366	173,746	38'1	35'2	35'1
Oats	5,157,000	5,305,000	1,032,194	1,110,811	40'0	38'2	39'0
Beans	26,900	32,800	5,728	6,654	37'6	39'4	37'0
Hay from Rotation Grass	<i>Tons.</i> 694,000	<i>Tons</i> 521,000	425,244	394,246	<i>Cwt.</i> 32'6	<i>Cwt.</i> 26'4	<i>Cwt.</i> 30'8
Hay from Permanent Grass	144,000	104,000	104,960	101,156	27'4	20'5	29'7
Hay from Timothy Meadows	105,000	87,000	47,208	46,523	44'6	37'3	
Potatoes	1,237,000	832,000	162,469	154,596	<i>Tons</i> 7'6	<i>Tons</i> 5'4	<i>Tons</i> 6'4
Turnips and Swedes	7,693,000	7,146,000	425,253	426,451	18'1	16'8	16'3
Mangolds	29,000	43,000	1,776	2,507	16'4	17'0	19'6

serious extent; turnips are, however, a rather poor crop in the south-western counties. Mangolds are an indifferent crop, especially in the south-western counties; sowing was late and progress was slow during the earlier months owing to dry weather and cold nights in June. The crop is generally free from disease, but in many districts the bulbs are small.

The total produce of wheat, amounting to 260,000 qrs., is less than that of last year by 123,000 qrs., or 32'1 per cent.; the area under the crop is less by 25,150 acres, and the yield per acre, 38'2 bushels, is 0'3 bushel below that of last year, and 1'3 bushel below the decennial average. The area under wheat this year is the smallest recorded since 1910. Barley, with a total produce of 973,000 qrs., shows an increase of 209,000 qrs., or 27'4 per cent.; the area under the crop is greater by 30,620 acres, and is the largest since 1907. The yield per acre, 38'1 bushels, is 2'9 bushels higher than last year, and 3 bushels above the decennial average. The total produce of oats, 5,157,000 qrs., falls short of last year's crop by 148,000 qrs., or 2'8 per cent. The area under the crop

shows a diminution of 78,617 acres, but the yield per acre, 40 bushels, is 18 bushel greater than last year, and is 1 bushel above the decennial average. Beans show a decrease in total produce of 5900 qrs.; the area under the crop is less by 926 acres, while the yield per acre is 18 bushel lower than in 1919, but is above the decennial average by $\frac{3}{4}$ bushel.

The total produce of hay, taking all kinds together, is 943,000 tons, which is greater than that of last year by 231,000 tons, or 32.4 per cent. Hay from rotation grass shows a total produce of 694,000 tons, an increase of 173,000 tons, or 33.2 per cent. The area is greater by 30,998 acres, and the yield per acre, 32.6 cwt., is 6.2 cwt. above last year's yield and 1.8 cwt. higher than the decennial average. Of the other hay, the total produce of which amounts to 249,000 tons, the ordinary meadows yielded 144,000 tons, and the timothy meadows 105,000 tons; the former, with an increase in area of 3804 acres, shows a yield 6.9 cwt. above that of last year, while the latter, with an increase of 685 acres in area, shows a yield higher by 7.3 cwt. The average yield of the two together, which is not shown in the Table, is 32.7 cwt., or 3 cwt. above the decennial average.

The total produce of potatoes is estimated at 1,237,000 tons, which is 405,000 tons more than last year, and is the largest recorded since the Returns of Produce were first collected in 1885. The area under the crop shows an increase of 7873 acres, while the yield, 7.6 tons per acre, is 2.2 tons more than in 1919 and 1.2 ton above the decennial average. Turnips and swedes show an increase of 547,000 tons, the total being 7,693,000 tons. The area under the crop is less than in 1919 by 1198 acres, but the yield per acre is 1.3 ton above that of last year and 1.8 ton higher than the decennial average. Mangolds, with a total produce of 29,000 tons, show a decrease of 14,000 tons; the area is less by 731 acres, and the yield, 16.4 tons per acre, is 0.6 ton below that of last year and 3.2 tons below the decennial average.

THE Women's Rural Institutes continue to grow in number, and there has been a marked development during the past year on the

Scottish Women's Rural Institutes. part of those which have now been established for some time. There is an increasing demand for classes and increasing readiness to contribute the expenses and fees of lecturers.

In June 1920 a deputation from the Advisory Committee approached the Secretary for Scotland for the purpose of urging that the work begun by the Board should be continued on the lines hitherto adopted. The Secretary for Scotland promised to give the matter his favourable consideration, provided that the recommendations of the Advisory Committee were adopted by a large majority of delegates at the Annual Conference. A scheme whereby the Board was requested to continue to assist the Institutes was put forward, therefore, by the Advisory Committee and adopted by the ballot vote of 204 delegates to 2.

This scheme, which is as follows, is at present under consideration.

THE INSTITUTE.—Subject to the condition that no Institute shall be used for purposes of party, political or sectarian propaganda, the Institutes shall be self-governing bodies, having control of their own affairs, financial and otherwise.

Institutes shall be entitled to recognition by the Board of Agriculture for Scotland, and to assistance and advice, provided that they fulfil the necessary requirements.

WOMEN'S COUNTY ADVISORY COMMITTEES.—Pending the formation of district groups of Institutes, and provided that it is not already represented, an Institute which has held its second business meeting shall be eligible to elect a member to the Women's County Agricultural Committee if asked to do so by the Board of Agriculture for Scotland.

AREA CONFERENCES.—A Conference shall be convened by the Board of Agriculture for Scotland biennially in each area.

Where any question arises in regard to the determination of areas, this shall be settled in accordance with the wishes expressed by the majority of Institutes in the county under discussion.

Constitution.

The Conference shall consist of—

- (1) Two delegates elected by each Institute, one of whom shall if possible be the Secretary, and the other a member elected by the ballot vote of the members.
- (2) Members of the Institutes other than delegates.
- (3) Representatives of the Board of Agriculture for Scotland.
- (4) Persons invited for special reasons.

The right to vote shall be confined to Institute delegates.

Powers.

- (1) To receive the report of the outgoing Area Committee.
- (2) To elect an Area Committee, consisting of representatives from each county or district of a county.
- (3) To discuss matters of general policy, and to make recommendations to the Board of Agriculture for Scotland through the Central Committee.

AREA COMMITTEE.

Constitution.

The Area Committee shall consist of representatives of each county elected by the ballot vote of the delegates from the Institutes in each county respectively at the Conference.

N.B.—The number of representatives from each county shall be settled in accordance with local circumstances.

Powers.

- (1) To receive and administer such funds as may be available for the area.
- (2) To encourage work in connection with Institutes in the light of policy suggested at the Conference.
- (3) To elect by ballot vote two of their members to serve on the Central Committee for Scotland.

- (4) To convene meetings of the Institutes within their area as they may deem desirable, or when they are requested to do so by a two-thirds majority of the Institutes in the area, the expenses of these to be a charge on area funds.

CENTRAL COMMITTEE FOR SCOTLAND.

Constitution.

The Central Committee shall consist of two members from each area, elected by ballot vote of the Area Committee, and of a representative of the Board of Agriculture who shall act in an advisory capacity only.

Powers.

- (1) To receive moneys which may be donated or left to the Institutes.
- (2) To administer the same in the general interests of the Institutes.
- (3) Where desirable to raise funds which may in their opinion be required for the furtherance of the Institutes' work.
- (4) The Central Committee, with the addition of a member from each of the Agricultural Colleges, shall have powers to co-opt four members, to represent any aspects of rural life affecting women which might otherwise be insufficiently represented, due consideration being given to names recommended by the Board of Agriculture for Scotland. The Committee so constituted shall form an Advisory Committee to the Board of Agriculture for Scotland.

THE BOARD OF AGRICULTURE FOR SCOTLAND—

- (1) Shall collect and disseminate such information in agriculture, rural domestic economy, handicrafts and rural industries as may be required by Institute members, and shall refer them to the appropriate sources of information for those aspects of their work which fall outwith the Board's province.
- (2) Shall form new Institutes, and revisit Institutes with a view to awakening and stimulating interest in different aspects of their work, and of receiving information which may be of value to other Institutes and to the central office.
- (3) Shall render such assistance in administration as may be necessary, and as may be advised by the Area Conferences, through the Central Committee.

N.B.—Much work in connection with Institutes must necessarily be of a voluntary character. As the movement develops, the machinery provided by the Area and Central Committees will allow scope for this, and will probably be supplemented by the voluntary grouping of Institutes. On the other hand, the Board will continue to be responsible for the specialised service which is needful in a national undertaking of this nature. The Area Conferences and the Central Committee acting in their advisory capacity will provide the necessary link between voluntary and official effort.

THE weather during September was to a great extent unfavourable for harvest work; the first three weeks were very unsettled, with

**Agricultural
Conditions.**

some bright days, intermittent rain, heavy dews, and an absence of drying winds. Conditions improved very much during the last week of the month, the weather being dry and fairly bright. Harvest was late on account of the lack of sunshine and warmth during the summer months, and the work was unusually protracted owing to the unfavourable conditions during the greater part of September. During October the weather was favourable for the completion of harvest work in the northern, western and southern counties, and in these districts the cereal crops were secured generally in good order and the potatoes lifted and stored in dry condition. Mild but misty weather prevailed throughout the month in the central and eastern counties where, owing to the absence of drying winds, more or less serious damage occurred to the cereal crops through sprouting in the stooks and heating in the stacks. In the early part of the month heavy rain fell in many districts, causing damage to the crops and delaying farm work generally. The weather during the greater part of November was dry and mild on the mainland of Scotland, but in the western islands it was very boisterous and heavy rain was frequent. Some damage was caused to stackyards in the eastern counties by a heavy gale in the middle of the month.

The bulk of the wheat crops was secured by the end of September, but owing to the humid weather, the harvest in some of the eastern districts was only completed in the latter part of October. The quality of the grain is very indifferent in many parts of Perth and Forfar. The total yield is estimated to be 123,000 qrs. below that of last year. The harvesting of barley was also more protracted than usual and was not quite completed at the end of October. The reports on the condition and quality of the crop are very similar to those received in the case of wheat, in several of the central and eastern districts the grain is reported to be of inferior quality, while elsewhere it is stated to vary from fair to good. The yield of barley shows an increase of 209,000 qrs. and is the highest since 1907. The oat crop was secured in many districts by the end of October, but in some of the northern and north-eastern districts and in the later areas of the south-eastern counties it was about the middle of November before operations were completed. The crop suffered more or less in many districts from various causes, and the yield and condition alike are in many parts below the normal. The total produce falls short of last year's crop by 148,000 qrs.

The lifting of potatoes was finished or practically finished in the great majority of the districts by the end of October or early in November. Operations were hindered in the eastern counties by wet weather in the early part of October, and in many other parts progress was slow owing to the lateness of the grain harvest. The crop has proved a good one generally, and disease is not prevalent to a serious extent; the total produce is 405,000 tons more than last year and is the largest recorded since the Returns of Produce were first collected in 1885.

The lifting of turnips and swedes was completed or well advanced in a few districts at the end of November, but in many cases they are only being lifted as required. The crop is a good one in the great majority of districts, but in the south-western counties it is much below the normal. The total yield shows an increase of 547,000 tons and the yield per acre is also considerably higher than last year. Mangolds are generally free from disease, but in many districts the bulbs are small and the yield is estimated to be 14,000 tons less than in 1919.

"Seeds" grass is almost everywhere reported to be vigorous and healthy; clover is unusually abundant in Forfar, Perth, the Lothians, Peebles and Ross.

The conditions during November were very favourable generally for outdoor work, and good progress was made with autumn cultivation. In the northern and eastern counties the work proceeded practically without interruption; in the western and south-western districts cultivation was not retarded to any extent, but in the western islands work was hampered considerably owing to the wet weather.

Notwithstanding the late start made in many districts, the sowing of wheat was well forward generally at the end of November. Sowing was completed in Moray and Central Perth, and in all cases the seed was got in in good order.

Feeding cattle are generally in good condition and have made average progress. Grass has been plentiful and winter keep is an ample supply practically everywhere. Sheep are in exceptionally good condition in most parts. Pastures have kept unusually fresh and green, but in South-West Forfar the strong growth is stated to have caused heavy mortality among wintering sheep, and in Moray some losses are attributed to the same cause.

The supply of regular labour is now adequate for requirements in most districts. In Kincardine, shepherds and experienced cattlemen are difficult to secure, while casual labour is short in parts of Fife, Perth, Berwick, Lanark and Kirkcudbright.

RECENT PERIODICAL LITERATURE.

Variation and Correlation of Characters in Wheat: Investigations in U.S.A. A. C. Arny and R. I. Garber, *Jour. of Agric. Research*.—During the four years 1914-1917 the author has studied biometrically the variation and correlation of characters in wheat and has drawn the following conclusions:—

- (1) The magnitude of the means is generally much influenced by environment. Lower yields of straw per plant resulted from a deduction in number, total length or average length of culms. Lower yields of grain per plant resulted from a reduction in the number of grains.
- (2) Generally (but there were numerous exceptions) a reduction in the magnitude of the means is accompanied by less variability.
- (3) Correlation between weight of seed sown and resultant plant characters is not high and may be diminished up to extinction by environment.
- (4) Correlation between different plant characters can also be modified by environment in degrees varying with the characters considered.
- (5) Increased yield of grain per plant is very closely correlated to the increase in the number of grains, number of culms, and total length of ears; it is slightly less closely correlated to the increase in average weight of the grains per plant, average height of culms, and the average length of ears.

- (6) A larger number of culms per plant is accompanied by a greater total length of ears, but not by a greater average length of ears.
- (7) Average weight of grain per plant, much influenced by environment, is closely and fairly constantly correlated with yield of grain and less closely correlated with the average length of ears. On the other hand, the correlation is weaker, but constant, with the number of grains per plant. Average weight of grain is practically independent of average length of ears.
- (8) There is a tendency for greater average height of culms to be accompanied by a greater average length of ears, number of grains, and yield per plant. On the contrary, the correlation between average height of culms and number of culms per plant is always low.
- (9) The correlation between average length of ears and average weight of grain per plant was low in three out of the four years of the experiments.

It is important to notice the disturbing effect of external factors (soil and climate): not only did it cause the coefficients of variability to fluctuate within wide limits, but it also modified the coefficients of correlation to such an extent as sometimes to change the sign.

Practical Results.—The tendency to produce increased yield shown by the tallest plants and those having the greatest number of culms is a valuable index in making individual plant selections from mixed populations.

Comparative Cultural Tests of Eleven Varieties of Oats at Domnarvet, Central Sweden, from 1905-1917. *George Nilsson.*—These cultural tests aimed at a comparison of certain varieties.

The Björn oat of Svalöf, produced from the cross Ligowo × Nordfinsk black oat, is earlier than Ligowo, it yields well, it has strong straw and its grain is black.

Orion is another oat also produced at Svalöf from the cross Ligowo × o668 (o668 is a line of Merö oats). It is early, its grain is of good quality, and, in the central and northern parts of Norrland, its yield is really high.

Yield of Grain and Straw.—Seger holds first place with 3129 kg. per hectare and a yield index of 106.5 (Guldregn=100). This variety grows as far north as the 60th parallel of latitude, in the southern districts of Dalarna but there it quickly loses its earliness and gives place to Guldregn, which is earlier.

Ligowo oats are clearly inferior to the two kinds noted above: its index of production=92.6.

In the least favourable parts of Dalarna the Guldregn variety is too late and should be replaced by other kinds, for example, by oat o1163 derived from the cross Guldregn × Svalöfs Dala.

The very early varieties Björn (2607 kg. per ha.) and Orion (2513 kg. per ha.) are better than Nordfinsk (2245 kg. per ha.) by 17.4 per cent. and 9.2 per cent. respectively. In production of straw, Seger again takes the first place (4561 kg. per ha.) and Guldregn comes next (4518 kg.); Orion is among the last with 3082 kg.

Quality of Grain.—The following characters are considered:—percentage of naked grain to unhusked grain; weight in gm. of 1000 grains; weight in kg. per hectolitre; percentage of double grains.

Guldregn stands at the head of the list for weight per hectolitre, while the indigenous oats Nordfinsk and Common Dala are among the last. Ligowo has larger grains and consequently has a high weight per 1000 grains; Seger and Orion follow it closely, the latter having precisely the character of Ligowo.

The percentage of naked grain is certainly a very important character; for this, Guldregn holds the first place with 76.1 per cent., and if the yield is expressed in naked grain the difference between Guldregn and Seger is considerably reduced. Comparing the data on the quality of Domnarvet grain with that of Ultuna, the weight per hectolitre, the weight per 1000 grains, and the percentage of naked grain are all clearly inferior in the latter place. The quality of the grain, provided ripening is certain, improves as it is grown farther north.

Earliness.—This is a character whose importance is more and more manifest as the latitude and altitude increase; a gain of even a few days in ripening considerably reduces the risk of early autumn frosts.

Among the three fairly early varieties tested, Ligowo and Guldregn are equally early; Seger, on the other hand, ripens some days later; this is why Guldregn is more cultivated in Dalarna.

Of the early kinds, on the average, Mesdag ripened ten days and Svalöfs Dala six days before Guldregn. Generally, the other varieties were alike and were about as early as Svalöfs Dala.

Nitrates, Nitrification and Bacterial Contents of Five Typical Acid Soils as affected by Lime, Fertiliser, Crops and Moisture. *H. A. Noyes and S. D. Conner, Jour. of Agric. Research, Washington.*—An investigation dealing with the formation of nitrates in the soil, and with bacterial activities (as represented by the number of bacteria present), as well as with the correlation of these two factors under specific conditions of the soil.

Controlled greenhouse experiments were carried out upon five typical acid soils. In part of the experiments the soils were fertilised with calcium carbonate, super-phosphate and complete fertiliser, cropped to wheat and clover, and kept at optimum moisture content, while in the other part the soils were unfertilised, uncropped, and kept respectively one-fourth, one-half, and fully saturated with water. The results obtained include crop yields, soil-acidity determination, nitrates in the soils when sampled and after incubation with ammonium sulphate, and also the number of aerobic, anaerobic and carbon-dioxide-surviving micro-organisms present in the soil.

The amount of nitrates present, and the nitrifying power of the untreated soils varied with the organic matter and total nitrogen, rather than with the acidity of the soil.

Manuring tended to increase nitrification, but not to the same extent as calcium carbonate; but on the other hand, independently of the different treatments, the presence of growing clover kept down the nitrate contents of the soils.

The degree of saturation of the soils affected the nitrates present, and as a rule more nitrate was found in soil kept one-half saturated with water than in soil kept one-fourth saturated. The soils that had been kept fully saturated with water for ten months contained no nitrates, and formed none when incubated with ammonium sulphate. The ratio of nitrates present in the uncropped soils before incubation to the nitrates present after incubation shows that the nitrate content of these acid soils tends to reach an equilibrium, above which no increase is obtained without additional treatment.

The bacterial flora varied in the different soils, and no bacteria developed into colonies visible to the naked eye as long as the plates were incubated in an atmosphere of flowing carbon-dioxide gas. Calcium carbonate additions increased the bacterial content of the soils. This increase was largely in the aerobic organisms. The use of a complete fertiliser produced but small increases in the number of bacteria. The degree of saturation at which the soil was kept changed the proportions between the aerobic, anaerobic and carbon-dioxide-surviving bacteria.

Cultures from soil samples that had been kept one-fourth saturated with water contained the largest proportion of organisms forming mould-like colonies. Under optimum moisture conditions, both with and without the addition of lime and fertiliser, the nitrates after incubation varied directly with the number of aerobic bacteria. In general, the larger the aerobic bacterial content and the nitrifying power of the soil, the larger the crop yields, and these investigations show the reasons why it is worth while to adopt a system of soil improvement which includes the addition of lime, phosphate and organic matter. It is evident that soil-fertility investigations should include both the chemical and biological examination of the soil.

The Influence of Chlorides on the Growth of Certain Agricultural Plants. *W. E. Tottingham, Jour. of Amer. Soc. of Agronomy.*—A preliminary study of the influence of chlorides on the growth of certain agricultural plants. A survey of the scientific literature dealing with the physiological part played in the plant organism by chlorine shows that the various investigators hold very different opinions. While some consider chlorine to be indispensable to the plant's nutrition, others regard it as useful, but not essential. Further, previous field and greenhouse experiments have proved that the effects of chlorides upon plants are extremely variable, and depend to a large extent upon

the species, the type of soil, and the complex of factors considered as climate. The writer has studied the effect of the chlorides of sodium and potassium upon different plants growing in Knop's solution in the greenhouse and, in certain cases, in the field.

The introduction of potassium and sodium chlorides into water cultures but slightly affected wheat plants during the first five weeks after germination. Buckwheat, on the other hand, was decidedly affected by the addition of these chlorides. Although the seed production remained apparently undisturbed, the length of roots and the yield of dry matter were reduced. The radish in soil cultures in the greenhouse responded only slightly to the application of potassium and sodium chlorides together with a complete fertiliser. Under the same conditions, these chlorides had a favourable effect upon the carrot, increasing the yield of dry matter and the percentage of sugars; the reverse, however, was found to occur in the case of the parsnip.

The potato produced increased yields of dry matter in the tuber, when potassium chloride was applied in place of potassium sulphate. As regards the percentage of starch, different varieties of potato responded differently; in some it was decreased, while in others it remained unaffected. The results indicated that the variety of plant was more important than the type of soil in determining this effect of the chlorides. In field crops sometimes the chlorides produced a decrease in the dry matter of the tubers without altering their quality (Triumph variety), while at others no noticeable change was effected (Rural New Yorker). Sodium chloride applied alone altered the composition of the tubers but slightly, though it affected their quality seriously.

On the whole, it appears quite possible that further investigation may lead to the development of practical rules for the use of chlorides in agriculture, due account being taken of these crops injured by these compounds, and of climatic and soil conditions.

The Manganese of Basic Slag and its Effects on the Growth of Wheat.

J. S. MacHargue, Jour. of Industrial and Engineering Chem.—The objects of the experiments described in this paper were to study the effect of manganese on the growth of wheat under different conditions, and to find out a new source of this element for agricultural use.

In the case of water cultures, a certain amount of manganese was found to stimulate the growth of wheat and increase the nitrogen content of the grain. With pot cultures, the best results were obtained by adding 5 gm. of carbonate of manganese per 8'500 kg. of soil—that is to say, by using 0'028 per cent. of manganese.

The writer examined some samples of basic slag which he found to contain an average of 5 per cent. of manganese, hence he suggests that it is possible that some of the benefit to crops resulting from the use of this fertiliser on certain soils may be due to this element.

Utilisation of Street Sweepings and the Droppings of Animals at Trieste.

D. Tamaro.—Trieste, a city of over 200,000 inhabitants, collects daily 90 tons of sweepings. In view of the difficulties of transport caused by the war and of the great scarcity of manure, Ing. Pio Sauli, of the Technical Bureau of the municipality, conceived the idea of enriching part of the sweepings by mixing them with the dung of horses and other animals collected daily in the streets of the city, so as to obtain a compost which was sold at 20 crowns (21 fr. at par) per ton at the shipping wharf.

The remainder of the sweepings, after having been roughly separated from pieces of glass, tins and similar objects, was incinerated in continuous furnaces alight, composed of 3 batteries. During the four years of the war the average heat value furnished by the sweepings was 1400 calories, which corresponds to one-fifth of that furnished by good coal. The thermic power obtained daily was equal to that of a coal plant consuming 180 to 200 quintals of coal daily and gave an electric energy of 875 h.p., which was used to supplement the central electric station in the city.

The slag (vitrified ashes) taken from the kilns is immediately plunged while incandescent into water so as to yield a fragile mass more or less pulverised. After sifting, the finest part is used as manure; the coarser part is used for buildings of reinforced concrete and for making concrete bricks.

The fine slag has the following percentage composition:—lime 40'5, silica

18, alumina 6, ferric oxide 4, magnesia 3.6, phosphoric anhydride 1.03, chlorine 0.26. It corresponds, therefore, to a tetraphosphate and can be used as an excellent phosphate of lime fertiliser: it has been sold to farmers at 3 crowns, 3.15 fr. per ton.

To derive a real manure, Ing. Sauli added to the incinerator the "crematorio"—that is to say, the industry that utilises the bodies of animals, meat seized as unfit for consumption, the bodies of stray dogs, etc. Altogether one ton of such refuse is collected in Trieste daily. The animals are skinned, cut in pieces and boiled in an autoclave. The products are fats used in soap factories, meat meal which is used for fattening (chiefly pigs), and as manure; the bones are broken, ground to powder, and used as manure; with the broth, which is very thick and contains much colloid and nitrogenous matter, is mixed powdered slag, the mixture is caked and sold as manure, and contains 41 per cent. of slag, 1.1 per cent. of nitrogen, 1 per cent. of phosphoric anhydride, 0.5 per cent. of potash; it sells at 20 crowns a ton. To make this manure more nitrogenous, meat meal, which contains 8 per cent. of fat, 56.97 per cent. of organic nitrogenous matter, 20 per cent. of ash, is added. The bone meal is not sold pure, but is mixed with an equal part of slag; an excellent complete manure is thus obtained, having the following composition:—13.13 per cent. of organic nitrogenous matter, 17.35 per cent. of phosphoric anhydride, 9.84 per cent. of silicates; 20 per cent. of lime. The broth or the colloid liquids contains 43.69 per cent. of animal nitrogenous substance, corresponding to 7 per cent. of organic nitrogen. All these manures are very much in request, especially for kitchen garden use.

Transformation of Explosives into Fertilisers. *S. Lissone, Milan.*—

Unused explosives which fill military magazines may constitute very rich nitrogenous fertilisers as they contain much ammonium nitrate, but it would be dangerous to make them over as they stand to cultivators. For this reason the Italian Government has employed Professor F. Garelli, Director of the Laboratory of Industrial Chemistry of the "R. Politecnico" of Turin in studying how to transform explosives into fertilisers. For separating the nitrate of ammonia from the mixture Professor Garelli takes advantage of the great solubility of this nitrate in water. By adding a fixed quantity of water to the explosive mixture in special vessels and letting the thick liquid settle he obtained a dense solution of nitrate of ammonia which he decanted. To this solution he added and mixed powdered peat, and after rapid drying he obtained a fertiliser which he calls "nitrated peat," and which has the following composition:—water 17.8, ash 18.8, nitrate of ammonia 42.8, organic matter 20.6. This fertiliser is a blackish powder and contains 16.4 per cent. of nitrogen (7.5 per cent. of nitrific nitrogen, 7.5 per cent. of ammoniacal nitrogen, 1.4 per cent. of organic nitrogen) plus 0.6 per cent. of phosphoric anhydride and 1.8 per cent. of potash. Its composition is therefore similar to that of nitrate of soda and can be used instead of the latter in manuring cultivated land.

Experiments required for ascertaining the fertilising value of "nitrated peat" have been entrusted to Professor Chieff Gamacchio, Director of the Provincial Professorship of Agriculture at Turin, but the results of some experiments made in the Alba district already warrant the assertion that the new fertiliser has an effect about equal to that of nitrate of soda.

Research as to the Nature of Telegony. *Comptes rendus des Séances de la Société de Biologie.*—The body of observations invoked for and against the theory of telegony is not sufficiently known. It must be allowed that certain related facts are evidence some for, and others against, telegony in so far as it is an apparent phenomenon. These facts, however, tell us nothing on the subject of the nature of the phenomenon. Further, nothing is known of the genetic constitution of the animals on which the observations were made.

In order to investigate the inmost nature of the phenomenon, the author made a series of experiments the results of which he briefly sets forth.

The problem to be solved was stated as follows:—"Can the genetic constitution of a female, consequent on fertilisation by a male phenotypically and genotypically different be influenced in such a manner that it constitutes in fact a new genetic constitution?" To remove as far as possible erroneous causes the author worked on the colour of rabbit fur, the mendelian factors of which are well known. Numerous preliminary experiments had, also, assured him of the presence of the factors in question.

A pure black doe rabbit was mated with a blue agouti buck (slate-blue with white belly). The author used a blue agouti as male parent because he brought two types of factors into play by doing so, one active, the factor agouti G, and the other passive, the absence of the factor of intensity D, which transforms blue into black.

In order to prove whether the black doe was influenced by the blue agouti buck, or by its products, this doe was next mated with an albino buck. The latter not being coloured, this was the best way of accentuating the eventual modifications caused in the genetic constitution of the doe. The mating of the black doe with the albino buck gave, in two litters, ten young ones all black agouti (wild).

At first sight this result might be considered telegony. The young wild synthetic black + blue agouti seem to have influenced the mother by the addition of a double dose of the agouti factor. It was not so, however. As a matter of fact, on investigation it was found that the albino buck had for genetic constitution $B_1 C_2 DG_1$ —that is to say, he was a wild albino with a single dose of the factor intensity of colour, D. The synthesis of black + wild albino should give wild rabbits. Nevertheless, as the albino buck had a single dose of D there ought to have been some blue agouti young in case of disappearance of the factor D in the black doe. This was not the case. It was, however, necessary to ascertain whether the four successive litters of wild young ones had not caused a modification of the genetic constitution of the black doe by introducing an agouti factor. To determine this point, the black doe was now mated with a chocolate-brown buck. She produced, in two litters, six black young rabbits. This shows that the doe had not been influenced and that her genetic constitution had remained unchanged.

The apparent telegony was due to two concordant and accidental syntheses of genetic constitutions producing the same type. When facts which seem to relate to telegony come to notice, it is necessary to ascertain whether the cause of the phenomenon is not the accidental formation of genetic constitutions producing the same phenotype. It is more than likely that the resemblance of the young of the same mother bred by two different fathers may be explained in this way in every case.

Horses in the Great War : Lessons and Aims. *R. J. Janini, Valencia.*—

The data on which the author bases his work were derived chiefly from first-hand information, verbal or written ; the remainder were gathered from publications on this subject. The lessons of the war regarding horse-breeding confirm the prediction of competent persons in recent years—namely, that very great importance should be attached to hardiness, strength and fitness in breeding horses for cavalry and artillery as well as for agricultural and draught purposes.

The English thoroughbred in spite of its great qualities possessed, as a war horse, grave defects of extreme nervousness and great requirements in the way of food and care, defects which had previously been deplored in the Crimean War.

The heavy Percheron and the Boulonnais have proved particular over food and little fitted for rough camp life ; they lacked frugality, nerve and hardiness. Breeding has deteriorated these races of large and stoutly built animals by reducing the Arab blood in them and has transformed them into expensive and less efficient draught horses. The same is the case with heavy English breeds of horses.

The best riding horses, as numerous French horse breeders, among them the Comte de Comminges, had foreseen, were Anglo-Arabs of the south of France ; the hardy Carmargue horses have also rendered excellent service. The qualities of small horses as draught animals are confirmed by the fact that the British Government purchased in France medium-sized Percheron mares to give a new direction to the breeding of draught horses in England.

Information relating to Canadian and Argentine horses are contradictory. According to some people Canadian horses have good qualities, but are extremely nervous. Argentine horses have confirmed their fame for hardiness and American horses turned out well.

Barbs and mules have rendered excellent services ; numerous data prove that Spanish horses and barbs form a single breed. Modern war has relegated the saddle horse to a secondary position ; in France, for example, before the

great war, cavalry took 70 per cent. of the army horses; at the present time the proportion is 8 per cent., while 92 per cent. are draught horses (artillery, staff, engineers, infantry; the latter requiring about 300 horses per regiment.)

The author applies this information to the direction which horse breeding for artillery ought to take in Spain; it should proceed on the same lines as that for agricultural horses. He shows that Spain possesses excellent stock for such breeding. In fact the whole Peninsula has a stock of horses in which, under more or less ugly shapes, great qualities of strength, hardiness and docility are hidden, due in a large measure to the prevalence of Libian blood which has flowed in their veins since very ancient times, and, as Professor Ridgeway has shown, it is entirely to Libian blood that Arabia owes its famous horses.

Food Value of Couch-Grass: Research in Sweden. *M. Weibull, Stockholm.*—The author had the opportunity of analysing some samples of dried, crushed couch-grass and obtained the following data (percentages):—protein 8.3, fat 1.2, nitrogen-free extract 62, cellulose 16.5, ash 5, water 7. It is evident that, in a time of scarcity, couch-grass can be used as cattle food; its nutrient value is nearly the same as that of hay, from which, however, it differs by its smaller cellulose content, which is rather advantageous. The nutrient value of couch-grass has already been recognised in other countries: according to Pott, couch-grass is often used, in Normandy, in place of oats in horses' rations; animals eat it eagerly with good results. Although the protein and fat contents of couch-grass are smaller than those of oats, couch-grass contains the same glucoside as oats—that is to say, coniferin, which in the animal organism serves in the synthesis of vanillin. The author adds that couch-grass is specially suitable for horses and sheep.

The Open Shed compared with the Closed Barn for Dairy Cows. *U.S. Dept. of Agric. Bull.*—Twenty-one cows were used in the experiment herd, being divided into two groups, which were kept alternatively in the open shed and the closed barn for three years.

In general, little difference could be noted in the contentment of the cows under either open-shed or closed-barn conditions. There seems to be little, if any, difference in the amount of actual sickness observed under the two conditions. But the closed barn was a modern, well-ventilated structure, and in many of the common poorly ventilated dairy barns the impure air would doubtless be an important factor in determining the comparative merits of the system. The period of housing cows is placed at an average minimum of five months, from November to March, for most sections of the United States.

The results of the experiments are summarised as follows:—

The cows consumed somewhat more feed and produced slightly more milk when kept in the open shed than when kept in the closed barn. The increase in production was not quite large enough to offset the extra feed cost.

When kept in the open shed there was a tendency for "boss cows" to deprive weaker individuals of their feed and of the normal advantages of the shed, which resulted in lower milk yields from the weaker and more timid cows.

All operations considered, milking and feeding excluded, slightly more labour was required to care for the cows when kept in the open shed.

The manure was apparently well preserved, until it could be hauled to the and, under the open-shed system. It was also handled more economically than in the closed barn. Cornstalks in the manure were sufficiently decomposed to be handled successfully with the manure spreader.

Under the open-shed system, 68 per cent. more bedding was required for each cow, but the cows were cleaner and more comfortable. There was little difference in the time required to bed them under the two systems. It is possible to use cornstalks or other coarse material for bedding in the open shed.

There appeared to be little if any difference in the frequency of injuries to cows under either open-shed or closed-barn conditions.

Correlation between the Percentage of Fat in Cow's Milk and the Yield. *C. Roberts, Jour. of Agric. Research, Wash.*—It is a generally accepted opinion that cows with a large yield of milk produce a smaller percentage of fat than do cows with a small yield of milk. To what extent this is true has, however, up to the present time never been demonstrated by careful scientific

investigation. From the study of the records of 2,166 Ayrshire cows, James Wilson ("The Separate Inheritance of Quantity and Quality in Cow's Milk," in *Scientific Proceedings of the Royal Dublin Society*, New Series, Vol. XII., No. 33, pp. 470-479, 1910) concluded that yield of milk and percentage of fat were inherited independently of each other.

In a criticism of this work ("Note on the Separate Inheritance of Quantity and Quality of Cow's Milk," *Biometrika*, Vol. VII., No. 4, pp. 548-550, 1910) K. Pearson, by means of a correlation table, showed that with an increase in the yield of milk there was a small but significant decrease in the percentage of fat.

In a later work (*The Principles of Stock Breeding*, pp. 121-122, London, 1912) J. Wilson states that high quality of milk—that is to say, milk rich in fat—is produced by cows giving all kinds of yields, high, average, or low, and the same may be said as regards milk of low quality. These facts would appear to prove that yield and quality are independent characters. It seemed to the writer, however, that it would be well to make a more careful statistical investigation of the matter.

A large body of data forming the greater part of the material for this investigation was furnished by the registers of the different American Associations for breeding milch cows. Only yearly tests were used. The method of finding the relation between the percentage of fat and the yield of milk was by means of the correlation table. The cows were divided according to their ages at the beginning of the experiment into the following four groups:—2 to 3 years; 3 to 4 years; 4 to 5 years; 5 years and over.

The writer concludes from the results of his investigations that a significant negative correlation exists between the percentage of fat in cow's milk and the yield for Jerseys, Guernseys, Holstein-Friesians, grade Jerseys, grade Holstein-Friesians, and cows unclassified as to breed. The correlation for Ayrshires is not significant in the subgroups classed in respect to age, but it is significant when these groups are treated as a whole.

The yield of milk increases with age. However, since all cows 5 years of age and over are classed together, it may well be that the yield decreases at some period beyond 5 years. Pearl and Patterson ("The Change of Milk Flow with Age from the Seven-Day Records of Jersey Cows," *Maine Agr. Exp. Bull.* 262, pp. 145-152, 1917) showed that in Jersey cows, when the seven-day records are used, the maximum production is reached between the eighth and ninth year.

C. Crowther ("Variation in the Composition of Cow's Milk," *Journal of Agricultural Science*, Vol. I., part 2, pp. 149-175, 1905), from his records of Ayrshires, is of the opinion that maximum production is close to the eighth year. In the Jersey, Guernseys and Holstein-Friesians the percentage of fat remains fairly constant for the different ages studied. However, the group of animals 5 years of age and over in the Jerseys and Guernseys shows a slightly lower percentage of fat than the younger groups. In the case of the Ayrshires, there is a gradual decrease with age. Between the youngest and the oldest groups there is a difference of 0.15 per cent. When judged by the standard deviation, age has no influence on the variability of the percentage of butter fat. But the class 5 years of age and over is more variable in the yield of milk than the younger groups.

This may be due to the inclusion in this group of old cows whose milk has decreased.

Using the standard of deviation as a basis of comparison, it is found that the breed has an influence on the variability of milk yield and percentage of fat. For variability in yield the breeds stand in the following order in an ascending scale:—Jersey, Ayrshire and Guernsey practically the same, then Holstein-Friesian. For percentage of fat the order is:—Holstein-Friesian and Ayrshire about the same, Guernsey, Jersey.

The average production of milk is as follows:—Holstein-Friesian 14,443.1 lbs., Ayrshire 9417.1 lbs., Guernsey 8644.4 lbs., Jersey 7491.4 lbs. The average percentages of fat for the different breeds are:—Jersey 5392 lbs.; Guernsey 5033 lbs., Ayrshire 3933 lbs., Holstein-Friesian 3435 lbs.

Cooling Milk and Storing and Shipping it at Low Temperatures. *U.S. Dept. of Agric., Dairy Div., Bull.*—This bulletin reports experimental work concerning the relative efficiency of cooling tanks of different construction handled

under varying conditions, the most efficient methods of cooling and storing milk on the farm, and the transportation of milk at low temperatures to market. The results are summarised as follows :—

Milk must be kept at a low temperature (50° F. or below) from the time it is produced until it is consumed if its quality is to be maintained. Prompt cooling of milk on the farm necessitates the most efficient use of water in both surface coolers and cooling tanks. Ice is needed if milk is to be cooled quickly to low temperatures. Cooling tanks should be covered, protected from the sun, insulated, and of such size as to use ice efficiently. Felt jackets or insulated cans proved to be very effective in keeping milk cold during long journeys in hot weather and in preventing freezing during cold weather.

Application of Ultra-Violet Rays in Dairies. *Datinchem.*—It is known that ultra-violet rays exercise a bactericidal action on the microbes in the atmosphere and in liquids. The loss of cattle, largely caused by microbes, especially by *Bacillus tuberculosis*, has suggested the idea of using the bactericidal action of these rays in dairy work. The Saxon Electrical Society "Elma" (Buhlau) has made for this purpose an apparatus producing ultra-violet rays, and consisting of a mercury lamp in quartz, combined with a system of lamps with metallic filaments giving infra-red rays. This apparatus is mounted on rails, in order that it can be moved to each part of the stable for irradiation of the animals. A special preparation also makes irradiation of the milk possible.

Action of Cold on the Smell of Meat. *L. Mahunt, Le Froid, Paris.*—The author recalls the fact that the "maturity" of meat can only be reached by the action of natural or artificial cold.

This action permits, whilst improving the meat, the development of digestive qualities, and of useful properties which it did not previously possess. It is only at the end of a period of three to five days that, during the cool season, the meat becomes juicy and savoury, and that roasting gives it an appetising odour.

But, in the summer, the meat ought to be cooked the day after slaughtering, for fear it should not keep, and it is then tough and unsavoury. In the interests of health and from the point of view of taste, only refrigerated or frozen meat should be eaten in the summer. The latter, when it is well thawed, without being of equal value to refrigerated meat, compares favourably with fresh meat.

Correlation between Egg Production during Various Periods of the Year in the Domestic Fowl. *J. A. Harris and A. F. Blakeslee, Genetics.*—Results of a biometric study of the relationships between egg-laying during different periods of the year in White Leghorn hens. The constants are based on two international egg-laying competitions held at Storrs, Connecticut. The constants for each of the two years are in very close agreement with each other.

There is a significant positive correlation between the number of eggs laid by a hen in any month of the year and the number of eggs laid in the whole year.

From a practical point of view, the result of greatest importance is the demonstration of the fact that trap-resting and record throughout the year are not necessary for obtaining conclusions of great value. The record of one month suffices for dividing the hens into groups differing widely in annual egg production. It would, therefore, be impossible, at the commencement of the laying season, after one month to divide the flock approximately into two halves, one of which will lay, on the average, 136 to 139 eggs a year and the other from 167 to 170; or, if it is thought desirable to retain only a quarter of the flock for laying, a production of from 176 to 187 eggs annually per hen may be secured. The selection of hens for breeding purposes in September or October would be made among the quarter containing the best laying hens of the flock whose annual average egg production would be about 190 eggs per hen.

On the Possibility of Breeders Obtaining Cocks or Hens according to their Wishes. *Lienhart, Comptes rendus de l'Académie des Sciences.*—The author's object was to ascertain the sex in the egg before incubation has commenced.

In all kinds of fowls the cock is always larger and heavier than the hen of equal age. The difference in the weights of the respective sexes varies, according to the breed, between 0.5 kg. and 1 kg. or sometimes even more. The author has remarked that this difference of weight, in a less degree, is noticeable in chickens; it even appears in the very young chicks (differences of 18 to 27 gm. for chicks of 5 days old). It was, therefore, natural to think that this difference in weight would also be found in the egg, but it was necessary to furnish experimental proof.

A first attempt gave no results, having been made with eggs of mixed-bred hens. In fact in a mixed breed all the hens, even if they belong to the same brood, do not lay eggs of similar weight. They group themselves, in this respect, according to their respective origins, and in the same hen-house where all the layers are similar—that is to say, all of equally mixed breed—distinct families exist, from the point of view of the average weight of the egg, regular lines which can be separated by selection, some laying small eggs, others eggs of medium weight, and others again that lay large eggs. Consequently, in choosing for experiment the larger eggs out of a lot laid by mixed-bred hens one simply eliminates all the eggs of maximum weights laid by the lines giving small eggs and takes only those of lines giving large eggs, and the selection of the eggs is illusory. It is therefore indispensable to carry out the experiment with eggs laid by a pure-bred race. This is what the author did in the spring of 1918, working with Leghorns. In that breed, the average weight of the cocks is 3 kg. and of hens is 1.90 kg.; the average weight of eggs is 62 gm.; the difference between extremes is 16 gm., the smallest eggs weighing 54 g. and the largest 70 g.; few eggs weigh less than 58 gm. or more than 66 gm. Sixty eggs, laid by hens all belonging to one brood and chosen out of the largest of a lot of 350, were placed in the incubator (these eggs weighed between 59 and 70 gm. each). On hatching, they gave 48 chicks of which 37 were cocks and 11 hens, a proportion of 77 per cent. of cocks. This result is convincing. It can, therefore, be affirmed that for a given breed and a homogeneous brood the heavier eggs ought to produce cocks and the lighter eggs hens.

The author has tried still further to improve his method. As all young hens of one year old lay eggs noticeably smaller and lighter than the normal average, and as, on the other hand, in course of the year, the eggs of the same layer, even if she is full grown, are noticeably smaller at the beginning and at the end of the laying season than in the middle, it is indispensable that all the laying hens should be of equal age and that the eggs should be collected when the laying is at its maximum. It would be well to set all the eggs of the selected lot, separating the heavier from the lighter.

By marking on each egg set to incubate its exact weight, by breaking it when it is about to hatch and by making a post-mortem examination of the chick to find out the sex, it would be possible to find, with regard to the initial weight of the egg, the sex which it contained and thus know the weight at which the determination of the sex by weighing becomes doubtful for a given breed.

Preservation of Eggs by Refrigeration after Preliminary Sterilisation. *Revue Scientifique.*—The methods of preserving eggs in use until these last few years, and consisting either in plunging the eggs into lime-water or into a solution of an alkaline silicate, or coating them with fats, such as vaseline, lard or paraffin, are very unsatisfactory methods. The eggs thus treated are often of a bad taste, and are not protected from putrefaction, because they have not been sterilised.

The cold-storage method itself, although used on a large scale (in America, for example, for over two milliards of eggs each year), is not sufficient to ensure perfect preservation. The cold, in fact, does not kill the ferment-causing germs which have penetrated through the shell before the operation; it only suspends their development, which starts again immediately the temperature rises to 1° C. In this way the waste frequently exceeds 5 per cent.

To preserve the egg fresh and wholesome with all its qualities, Lescardé discovered that it is sufficient to combine refrigeration with preliminary sterilisation in a closed vessel. The eggs are first tested by holding them to the light to eliminate those which are old or cracked; then they are shut in an autoclave attached to a vacuum pump; this operation has the effect of drawing out the

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gases contained in the little air space in the egg, and those dissolved in the albumin. Following this, carbonic gas and nitrogen, an antiseptic mixture with which the eggs are thus saturated, is introduced into the autoclave. The eggs, now being sterilised, are carried to cold rooms where the temperature is kept between 0° and 2° C. They can remain preserved thus a very long time; at the end of ten months the albumin has still retained its whiteness, the air space has remained very small, and the sterilised egg and a fresh egg differ neither in appearance nor taste. This method is already applied in several factories specially equipped for the purpose in France, Belgium and the United States.

Strongylosis in Turkeys in England. *The Field*.—This article gives a short account of a recent outbreak in a northern county of a disease fatal to turkeys. The disease, at first attributed to poisoning, continued when the flock was removed to fresh pasture and put on a new ration, and microscopic examination eventually showed that death was due to inflammation of the intestine due to the pressure of large numbers of minute parasitic worms of the "Strongyle type" of thread-worm. It is suggested that the outbreak may possibly harbour danger of a widespread infection and that steps should at once be taken for expert examination of remedial measures with a view to future control.

The Insect Pests of Natural Woodland. *Review of Applied Entomology*.—This is an interesting summary of a paper by Escherich dealing with the insect pests of the virgin forest of Bialowies in Lithuania. The investigator found that as a rule primary insect pests were not common in the natural woods; the leaves of trees were seldom injured and galls were very rare. On the other hand, secondary insect pests, in particular Scolytid, Buprestid and Cerambycid beetles were abundant, and could readily be found in the bark of conifers as well as other trees. Timber-infesting beetles were scarce compared with the bark-burrowers. The author reaches the important conclusion that in natural woodlands, such as Bialowies forest, injurious insects are of little importance, since variety of plant species, natural vigour of the trees and abundance of natural enemies combine to keep in check the pests. It is suggested, therefore, that good results will be likely to follow where cultural methods bring about conditions similar to those ruling in nature.

An Insect Pest of Imported Pines. *A Henry, Gardeners' Chronicle*.—There can be no doubt that *Chermes cooleyi*, a pest of the Douglas fir, is extending its range in England and Scotland. Fortunately, if observations made in British Columbia hold true for this country, the spread to new areas of Douglas fir is of little importance in itself; for the pest appears to have no harmful effect upon the health of Douglas fir; but a secondary danger threatens. In British Columbia one stage of the insect's life is passed upon the Sitka spruce, the stems of which become twisted and wither, so that a serious proportion of the trees are rendered worthless or killed. Now Sitka spruce is becoming increasingly planted in Britain, and the danger that *Chermes cooleyi* may spread from Douglas fir to the spruce plantations is a very real one. Specimens of branches of Sitka spruce found to bear galls (the galls are $\frac{1}{2}$ to 3 inches long, and have internal chambers varying in number from 40 to 200, and each containing 1 to 15 grubs) should be sent to an expert for investigation, full particulars of the attack being supplied at the same time.

Agricultural Tractors and War Tractors: The Problem of Adhesion. *C. Julien*.—The author discusses the question of the different types of wheels and gripping devices, and calls attention to a new type of wheel exhibited by "La Motoculteur Francaise." Before describing this new rim and its advantages in detail he calls attention to the following general points:—

- (1) That the problem of adhesion on rails, for all haulage machines, has found its general technical solution in the factor of weight: the heavier the locomotive the greater the load hauled, the heavier the chain-track tractors (Caterpillar and similar types) the greater their useful power at the drawbar.
- (2) That the problem of adhesion on roads for all motor vehicles, touring or transport, has found its general technical solution in the use of rubber tyres; a suitable relation between speed, weight and the rubber-tired wheel in contact with the ground permitting all requirements to be met.

Again, if the rail track and the roadway are, as surfaces for travelling on, very different from the surface of arable land and even of farm roads—to such an extent that dozens of different gripping appliances are employed among the hundreds of makes of tractors—it is not therefore to be excluded that a general technical solution should not be sought and could not be found for all machines which have to move their own mass over different kinds of ground, and especially for those machines which have, in addition, to show at a drawbar, for whatever purpose (transport, haulage, ploughing, etc.), a useful haulage force. Let us see what may be, in this respect, the bearing of the recent invention, of which the first application has been made to the driving-wheels of the Moto-culteur and to the driving-wheels of a lorry-tractor.

The patent specification states “the driving wheels of tractors or of divers agricultural machines should, as regards running, fulfil the following general conditions :—

- “(1) Have a practically smooth rim so as to be able, like ordinary vehicles drawn by animals, to run on highways and roads.
- “(2) Be provided, however, from the time when they reach the field, with normal possibilities for adhesion, which the flat rim alone could not give.
- “(3) Have means of adherence of progressive efficiency ready, so that the machine may be able, no matter what the difficulties in running are, to apply usefully to its maximum the available motive power to overcome these difficulties.
- “(4) This invention aims at fulfilling all these conditions by simple means.”

Such is the problem tackled by the inventor, and here is how he has solved it :

This result is obtained by means of a flat rim of circular shape, having fixed to its *inner* surface V-shaped protuberances which project beyond the edges of the rim on either side. Each protuberance may itself serve to support a complementary gripping plate which can be put on without screws or bolts and which projects out from the outer edges of the rim.

The appliance works as follows :—

While the rim, whether it be a flat iron one or one carrying a rubber tyre, has not the extra plate attached it can run freely on roads and highways.

Whenever the machine enters the field the rim tends to sink into the ground, so that the lateral projecting pieces become embedded in the ground also and the more the wheel sinks in the more they help to overcome the resistance to travelling.

As the number, size and position of these internal projecting pieces can be regulated in manufacture, it results that they will suffice in most cases to secure enough grip to the wheels when working.

Should the kind of ground or the work to be done be such that this permanently fixed device is not enough, the wheel then is further equipped with removable complementary plates which, sticking out beyond the wheel face, take a deeper bite on the soil for giving the maximum grip (as does a strake of the Stock type).

The projections, like the plates, may be arranged on one side only or on both sides of the rim, opposite one another or alternately.

The idea of thus seeking to obtain adhesion not on a circle of greater but on one of less diameter than the internal diameter of the rim, whatever the latter may be, would seem to solve in a neat and simple way a very difficult and hitherto insoluble double problem.

Its almost general application in time to motor cultivating machines—which are obliged to pass in turn from field to road and vice versa, and intended to exert very variable haulage efforts, according to the nature of the work and of the ground—would appear to be all the more certain (barring patent reservations), seeing that the appliances can be put on wheels for all powers and of all diameters for all kinds of tractors.

Its application to lorries and to all motor machines destined to pass immediately from roads on to different sorts of ground, either to move over them or to do haulage work on them, would also appear to be of greater interest, as a wheel so equipped with internally projecting pieces is always ready to work normally on road or field. The extra plates need be put in action only under exceptional conditions, being fixed in only a few seconds, without screws or bolts, as was demonstrated on wet ground at the trials.

The Motoculteur wheel will not stick: loose earth on which it is rolling lets the projecting pieces sink and always gets a hold on the solid bottom below, while any soil carried away falls back vertically if the projections, of triangular section, are set at a sharp enough angle and sufficiently apart from each other. The two driving wheels of the Motoculteur, placed on either side of the light strong chassis enclosing all the mechanism, confer on this machine, in its various forms, exceptional qualities, including non-slipping properties which neither the Stock nor the Caterpillar types can attain to.

Hence the advantage will be seen which tractors with four driving wheels may derive from the new rim with progressive adhesion powers, both for agricultural and for warlike uses, especially in the motor haulage of artillery and for supply columns.

The "Warwick" Patent Spiral Tiller. *Implement and Machinery Review.*—The "Warwick" Patent Spiral Tiller is placed upon the market by the Eagle Engineering Co. Ltd., Eagle Works, Warwick. The tool is described as a substitute for the garden rake, hoe and scarifier. It consists of a series of spiral coils, which gives the implement a drilling action when breaking up the soil. It can be used for preparing seed-beds after the ground has been roughly dug. Owing to its particular spiral design, the soil is quickly broken up to the depth required according to the pressure exerted, leaving an even, smooth surface for planting. A great advantage claimed for the tiller is that when drawn backwards and forwards over the soil it thoroughly pulverises hard and large pieces of earth. The "Warwick" is considered especially suitable for preparing lawns for seeding and for work usually accomplished by the aid of a garden rake. Operating as a hoe, it has been found to act with great success, uprooting weeds and leaving a smooth ground surface.

One-Handed Spade. *Revue Scientifique.*—M. Bessonnet Favre, a maker in the department of Vienne, France, has invented a spade, for persons who have lost one hand or one arm, which can be used with one hand.

It is naturally forced into the ground by the foot; when it has reached the required depth the end of an arc of a sector jointed at its centre with the socket of the spade comes into contact with the ground. The arc forms a fulcrum which enables the sod to be raised by pressure at the end of the handle and the sod can then be turned over by a turn of the hand.

Agricultural Costings Studies in the United States. *U.S. Dept. of Agric. Circular.*—Upon the request of the Secretary of Agriculture a Committee consisting of leading men in farm management and agricultural economics from the State agricultural colleges and the National Farm Management Association has given active assistance in suggesting and outlining future work for the Office of Farm Management. This Committee was asked to consider a broader and more clearly defined field of operations for the Office of Farm Management, to determine the co-operative relationships that should exist between Federal and State investigators, and to outline methods of procedure in developing projects and especially in determining the cost of production of agricultural products.

The Secretary of Agriculture, who approved the recommendations of the Committee, states that the projects proposed could be started and carried out in large part with available funds and that the work should be pushed as rapidly and vigorously as possible.

The Secretary will submit to Congress the new plan of organisation and ask for authorisation to establish a "Bureau of Farm Management and Farm Economics" and that additional and adequate funds be provided to place these important activities on a broad and satisfactory basis.

Organisation and Projects.—The work of the proposed "Bureau of Farm Management and Field Economics"—according to the Committee's report, could well be organised around the following projects. The nature of the work under these various projects is indicated by the names of a few sub-projects proposed.

Co-operative Relationships.—The Committee has recommended that the investigations of the Office of Farm Management requiring field work be

carried on in co-operation with the State colleges and experiment stations. Some of the benefits of such co-operation would be—

- (1) To prevent duplication and to correlate activities.
- (2) To promote the development of State departments.
- (3) To unify the methods and improve the general character of all farm management work.

Cost of Production Studies.—Cost of production studies, according to the Committee, are of value to the individual farmer and at the same time are helpful in ascertaining the economic status of farming as an industry.

Their results for a number of farms where a given type of farming is practised are useful not only to the farmers from whose farms the results were obtained, but are of value in showing other farmers how to improve their methods. From the standpoint of the public, cost of production studies provide the facts which give a basis for intelligent judgment upon the probable effects of any given legislation or other public activity upon the farmer as a producer and as a citizen. Cost of production studies are, therefore, one of the means of providing the basic facts needed by legislators and price commissions in comparing the profits of competing lines of production and estimating necessary prices.

The Committee's report gives a brief outline of the methods of cost investigations proposed, consisting of cost accountings, survey methods and questionnaires sent by post. The accounting method is based on complete records of all farm work and business transactions. Arrangements are made with farmers to keep detailed records of all operations and transactions in connection with the farm business. The work is supervised by personal visits to the farm. Cumulative results of such work (farm accounting statistics) become increasingly valuable.

By the survey method the necessary data are obtained from farmers by trained investigators. Some of the data are taken from the farmers' books; some from the books of persons to whom the farmer sells and from whom he buys; some from his bin, silo and building capacities; and some of the data are based on estimates made by the farmer.

Some of the advantages of the survey method are: (1) it is a relatively inexpensive method of securing records from large numbers of farms; (2) records are obtained from all classes of farms; and (3) records are obtained after the close of the farm year, so that, when desired, areas more representative of normal conditions may be chosen.

Both methods are useful and reliable when the work is carefully conducted. Either method may be used, but preferably both should be used. The detailed costs accounts serve as a check on the survey work, and the survey work shows the relationship of the farms on which cost accounts are kept to the average farm. The questionnaires sent by post can be used to advantage in securing supplementary data from a large number of farmers. To secure the best results the questionnaire should cover only a limited number of cost items and the questions should be direct and clear. A detailed grouping of cost items is suggested by the Committee for the farm cost accounting work.

OFFICIAL ORDERS AND CIRCULARS.

Revocation of Orders.—The Food Controller has revoked the Cereals (Restriction) Order, 1919, which restricted the purposes for which sound wheat might be used to seed and the manufacture of flour, the Use of Bread (Restriction) Order, 1920, the Flour (Returns) Order, 1920, and the Flour and Bread (Prices) Order, 1920, which prescribed maximum wholesale prices.

In future there will be one issue price for G.R. flour and the various grades of imported flour sold by the Royal Commission on Wheat Supplies, which will be fixed from time to time, having regard to market fluctuations.

The following Orders have also been revoked:—the Oil and Fat Compound (Licensing of Manufacturers and Requisition) Order, 1918, the Seeds, Oils and Fats Order, 1919, the Cattle Cakes and Meals (Licensing) Order, 1919, and the Milk Local Distribution Order, 1918.

The following notices have been issued by the Board to the Press:—

Export of Seed Potatoes to England.—The Board of Agriculture for Scotland desire to draw the attention of seed potato growers and merchants to the concession which has been made with regard to the planting of first early varieties of potatoes which are susceptible to wart disease in those districts of England and Wales which have been declared to be wart disease infected areas.

Potatoes.

A general licence has been issued by the Ministry of Agriculture and Fisheries authorising growers in these districts to plant seed potatoes of any true first early variety and also of the variety Eclipse and other varieties of that type except on land on which wart disease has been known to occur and on condition that the produce will be used for "ware" purposes within these districts only. The Ministry is also prepared to issue licences to growers and dealers in seed potatoes in these districts authorising the introduction of seed potatoes of these varieties into infected areas. This concession will remain in force until the 30th April 1924, after which date it is not proposed to permit the planting of any susceptible varieties of potatoes in infected areas.

The following varieties are recognised by the Ministry for planting under this concession :—

Duke of York, Midlothian Early, May Queen, Ninetyfold, Epicure, Sharp's Express, Ringleader, Riley's Early, Eclipse, Sir John Llewellyn, Lady Llewellyn.

No other susceptible varieties of potatoes may be introduced for planting in the infected areas of England and Wales with the exception of any other varieties of true first early types in respect of which a licence from the Ministry is obtained by the importer.

Exportation of Seed Potatoes to Holland.—The Board of Agriculture for Scotland draw the attention of exporters of potatoes to the regulations which the Netherlands Government propose shortly to issue for controlling the importation of potatoes into Holland. Under these regulations, potatoes imported into Holland must have been inspected at the time of lifting on the field where they were grown, and must be free from wart disease. A certificate to this effect must be issued, as regards potatoes grown in Scotland, by an Inspector of the Board of Agriculture for Scotland, who must also be present when the potatoes are bagged. Only new bags may be used for this purpose, and they must be sealed by the Inspector, who will then issue a certificate that the potatoes contained in the bag were grown on the inspected field. Persons wishing to export "seed" potatoes to Holland should, therefore, inform the Board immediately when it is proposed to lift any crops destined for export, in order that arrangements may be made for an Inspector to be present. The fee to be charged for inspection and issue of the certificate will be £1, 1s.

The Board would draw the attention of farmers and potato merchants to the terms of two orders issued by them on 8th December—viz. the Irish Potatoes Importation (Scotland) Order, 1920, and the English Seed Potatoes Importation (Scotland) Order, 1920—the main provisions of which are given below.

IRISH POTATOES IMPORTATION (SCOTLAND) ORDER, 1920.

Restrictions on Dealings in Potatoes from Ireland.

3. No person shall bring, or cause to be brought, into Scotland any potatoes grown in the districts in Ireland described in the First Schedule to the Black Scab in Potatoes (Special Area) (No. 4) Order, 1919, or grown in any other district which may hereafter, by Order or otherwise, be placed under control by the Department of Agriculture and Technical Instruction for Ireland for the purpose of preventing the spread of Wart Disease.

Powers of Entry.

4. An Inspector or any authorised officer, upon production if so required of his appointment or authority, may, for the purpose of enforcing this Order or detecting any violation of the provisions thereof, enter any premises or any railway station or harbour or dock, and examine any potatoes therein or in any railway wagon or in any ship, boat or other vessel.

Information regarding Potatoes imported from Ireland.

5. If so requested by the Board, or an Inspector or any authorised officer, any person who is or has been in charge of or in possession of potatoes imported or suspected to have been imported into Scotland in contravention of

this Order shall give all such information in his possession as may enable the Board to ascertain by whom the potatoes have been imported, and the district in Ireland in which they have been grown.

Disposal of Potatoes imported in Contravention of Article 3.

6. No person shall knowingly sell, purchase, plant, move or take delivery of any potatoes imported into Scotland in contravention of this Order.

7. If any potatoes are imported into Scotland in contravention of this Order, the Board or an Inspector or any authorised officer may, by the service of a notice on the consignee of, or on the person in charge of, or on the person in possession of, any of the aforesaid potatoes, prohibit the planting, use or removal of the potatoes except in accordance with such conditions as may be prescribed by the notice.

Offences.

8. Every person shall be liable on conviction to a penalty not exceeding ten pounds who—

- (1) imports any potatoes into Scotland in Contravention of this Order ; or
- (2) fails to do any act which by this Order or by a notice issued under this Order he is required to do ; or
- (3) wilfully obstructs or impedes an Inspector or any authorised officer in the course of his duties under this Order.

Commencement of the Order.

9. This Order shall come into operation on the twentieth day of December 1920.

ENGLISH SEED POTATOES IMPORTATION (SCOTLAND) ORDER, 1920.

Restrictions on Dealings in Seed Potatoes from England and Wales.

3. Except under the authority of and subject to the conditions, if any imposed by a licence granted by the Board, no person shall bring, or cause to be brought into Scotland any seed potatoes grown in England or Wales.

Powers of Entry.

4. An Inspector or any authorised officer upon production if so required of his appointment or authority, may, for the purpose of enforcing this Order or detecting any violation of the provisions thereof, enter any premises or any railway station, or any place where potatoes are loaded or unloaded and examine any potatoes therein, or any potatoes in any railway truck or wagon.

Production of Licences.

5. Any person by this Order required to obtain a licence shall on demand of the Board or of an Inspector or any authorised officer produce the same for inspection.

6. Any person who is or has been in charge of or in possession of seed potatoes suspected by the Board or by an Inspector or by any authorised officer of having been brought into Scotland in contravention of this Order shall, on demand as aforesaid, give all such information in his possession as may enable the Board to ascertain by whom the potatoes were brought into Scotland.

Disposal of Potatoes imported in Contravention of Article 3.

7. No person shall knowingly sell, purchase, plant, move or take delivery of any potatoes brought into Scotland in contravention of this Order.

8. If any potatoes are brought into Scotland in contravention of this Order, the Board or an Inspector or any authorised officer may, by the service of a notice on the consignee of or on the person in charge of, or on the person in possession of, any of the aforesaid potatoes, prohibit the planting, use of removal of the potatoes except in accordance with such conditions as may be prescribed in the notice.

Licences.

9. -(1) The Board, for any reason that may appear to them sufficient, may refuse to grant a licence under this Order and may revoke any licence issued by them under this Order.

(2) Any licence under this Order obtained by means of a false statement or misrepresentation shall be invalid.

(3) Any alteration or erasure made in a licence issued under this Order shall render it invalid.

Offences.

10. Every person shall be liable on conviction to a penalty not exceeding ten pounds, who—

(1) brings or causes to be brought into Scotland any potatoes in contravention of this Order; or

(2) fails to do any act which by this Order, or by any licence or notice issued under this Order he is required to do; or

(3) wilfully obstructs or impedes an Inspector or any authorised officer in the course of his duties under this Order.

Commencement of the Order.

11. This Order shall come into operation on the twentieth day of December 1920.

Export of Potatoes to Ireland.—The Potato Importation (Ireland) Order, 1920, issued by the Irish Department of Agriculture came into operation on the 15th November. Under this Order the importation of potatoes into Ireland is prohibited except under the authority of a licence to be obtained by the consignee in Ireland, and all potatoes imported must be accompanied by a declaration by the sender on a prescribed form. In the case of potatoes grown in Scotland, this declaration must state that a certificate has been issued by the Board of Agriculture for Scotland that the farm on which the potatoes were grown is not situated within a district declared to be an "infected area" for the purposes of the Wart Disease of Potatoes (Scotland) Order of 1918 nor within one mile of any land on which wart disease has occurred. This certificate is required in respect of both immune and non-immune varieties of potatoes, and in the case of the former it is also necessary that the potatoes should be taken from a stock inspected during the growing season and certified by the Board to be of satisfactory purity.

Export of Seed Potatoes.—The Board of Trade (Licensing Section) announces that as from the 16th inst. seed potatoes may be exported to all destinations, other than Soviet Russia, without a Privy Council licence, but certificates of freedom from disease are still necessary before export can take place to certain destinations.

The attention of owners, occupiers, superintendents and other persons having charge of slaughter houses is directed to the terms of the Maintenance of Live Stock Order, 1920, issued by the Board. This

Live Stock.

Order, which takes effect as from the third day of November 1920, prohibits the slaughter of in-calf cows, in-lamb ewes, and in-pig swine, except in specified cases.

The Board desire to request that all persons in charge of slaughter houses may report to them immediately every case in which a pregnant animal is brought to their slaughter house to be killed unless any of the exceptions stated in the Order apply to the case.

All licences issued by the Board or by an Inspector of the Board authorising the slaughter of pregnant animals *should be returned to the Board within three days after the slaughter of the animal.*

The main provisions of the order are as follows :—

THE MAINTENANCE OF LIVE STOCK (SCOTLAND) ORDER OF 1920.

Restriction of Slaughter of Animals In-Calf, In-Lamb, or In-Pig.

1. No Animal In-calf, In-lamb, or In-pig shall be slaughtered or sold or exposed for sale to be slaughtered.

Exceptions from Restrictions.

2. The restriction of slaughter imposed by the preceding Article of this Order shall not apply to—

(a) Slaughter of an Animal under the powers conferred by the Diseases of Animals Acts, 1894 to 1914, or any Order made thereunder, or

- (b) Slaughter of any animal rendered desirable by illness or accidental injury, or
 (c) Slaughter of any animal authorised by a licence granted by the Board of Agriculture for Scotland or an officer of that Board on cause known.

Power of Entry.

3. For the purpose of executing and enforcing this Order, any Officer of the Board of Agriculture for Scotland may, subject to any directions given by that Board, and upon production, if so required, of his appointment, enter any slaughter house or other premises on which animals are slaughtered for human food and examine any animal or carcase therein.

NOTE.—Penalties for Offences.—In terms of Section 2 of the Maintenance of Live Stock Act, 1915: "If any person acts in contravention of or fails to comply with any of the provisions of an Order made under this Act, or with a view to evade the operation of any such Order marks or alters or obliterates a mark on any animal, or obstructs or impedes any officer in the execution of his powers or duties under any such Order, he shall, on conviction under the Summary Jurisdiction Acts, be liable to a fine not exceeding twenty pounds; or, if the offence is an offence committed with respect to more than four animals, to a fine not exceeding five pounds for each animal."

The Food Controller has issued an Order reimposing, as from 25th October 1920, maximum prices for eggs. So far as home-produced eggs are concerned, the maximum prices are as follows:—

	Wholesale price per doz. s. d.	Retail price per doz. s. d.
Fresh Eggs (<i>i.e.</i> eggs that have not been preserved in any way)	5 4	6 0
Preserved eggs	4 5	5 0
Small Eggs (<i>i.e.</i> eggs weighing less than 1½ ozs.)	2 8	3 0

The following notice has been issued to the Press:—

Reduction in Prices of Sulphate of Ammonia.—The Board of Agriculture for Scotland announces that in view of the decline in the world prices of nitrogenous manures the makers of sulphate of ammonia have agreed to make a substantial reduction in the prices of this fertiliser for the remainder of the current season.

Under the arrangements which have been made, sulphate of ammonia will be delivered during January, 1921, in 4-ton lots and upwards at £23, 16s. per ton, a reduction of £2, 17s. 6d. on the maximum delivered price previously agreed upon for deliveries made during the month. The February price will be £24, 3s. 6d. and the March-May price £24, 11s. per ton. All orders already placed with the makers for deliveries during January to May will be executed at these revised prices.

The makers are also prepared to refund the following amounts on deliveries made earlier in the season provided that the claims for refundment are received by the British Sulphate of Ammonia Federation before 31st January 1921:—

Quantities delivered and paid for at the	August 1920 price	...	s. d.	9 0 per ton.
" " " " September	" "	...	22 6	" "
" " " " October	" "	...	32 6	" "
" " " " November	" "	...	42 6	" "
" " " " December	" "	...	52 6	" "

STATISTICS.

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS
in September, October and November 1920.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	SEPTEMBER.			OCTOBER.			NOVEMBER.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	117 6	108 4	85 4	117 4	07 6	86 3	122 8	112 4	87 9
Shorthorn ...	111 4	104 2	86 11	113 8	105 0	92 4	116 2	108 0	92 6
Galloway ...	109 6	100 7	93 10	100 6	94 6	87 8	107 9	100 6	93 3
Ayrshire ...	98 0	82 4	61 10	98 4	83 4	58 4	104 3	90 0	60 0
Cross-bred ...	113 10	104 5	86 9	112 3	102 5	84 9	118 0	109 1	89 0
Blue Grey ...	109 5	103 2	94 0	103 6	98 0	89 0	109 9	100 6	93 3
Highland ...	110 4	99 0	...	110 0	95 6	85 0	111 11	102 8	91 0
VEAL CALVES ...	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
	19	14½	11	21	15½	12½	21½	15½	12
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot ...	26½	25½	21½	26	25	21½	26½	25½	21½
Half-bred ...	26½	25	21½	26	25½	20½	26½	25½	21
Blackface ...	23½	21½	18½	24	22½	19½	24	22½	19½
Greyface ...	26	24½	18½	26	24½	19	26½	24½	19½
Down Crosses ..	26½	25½	...	26½	25½	...	26½	25½	24
Pigs—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs ...	28 5	26 6	22 6	28 0	25 5	22 3	27 0	24 7	20 4
Porkers ...	28 10	27 3	24 0	28 3	25 10	23 5	26 11	24 10	20 0

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	SEPTEMBER.			OCTOBER.			NOVEMBER.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
STORE STOCK:—									
STORE CATTLE—									
Aberdeen-Angus :	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.
Yearlings ...	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Two-year-olds ..	29 14	21 11	14 17	28 7	21 1	14 19	32 13	24 9	15 0
Yearlings ...	45 16	33 6	24 6	43 18	33 17	24 9	46 13	34 13	27 3
Two-year-olds ..									
Shorthorn :									
Yearlings ...	...	...	...	...	...	...	...	...	...
Two-year-olds ..	...	...	...	...	...	...	...	...	...
Galloway :									
Yearlings ...	25 0	20 1	16 0	26 18	22 0	16 15	28 10	22 17	17 7
Two-year-olds ..	43 7	37 13	30 5	44 0	37 10	30 0	45 7	36 1	30 9
Ayrshire :									
Yearlings ...	19 13	15 7	11 10	19 8	15 7	12 13	19 0	17 0	13 0
Two-year-olds ..	32 0	25 0	18 0	29 13	22 13	17 7	32 0	26 0	20 0
Cross-bred :									
Yearlings ...	25 8	19 19	14 8	26 3	20 13	15 0	28 16	22 0	15 8
Two-year-olds ..	43 17	34 3	26 13	45 1	35 12	27 14	45 4	36 1	29 4
Blue Grey :									
Yearlings ...	33 0	26 0	18 0	28 15	22 3	16 15		26 0	20 0
Two-year-olds ..	48 0	39 0	32 0	44 8	38 0	30 0	47 0	39 0	32 0
Highland :									
Yearlings ...	14 8	12 8	8 10	16 15	13 4	9 16	18 17	15 17	12 7
Two-year-olds ..	28 8	23 0	18 0	28 18	23 7	18 11	26 18	24 16	19 14
Three-year-olds ..	44 0	31 0	24 0	40 17	33 8	27 1	42 17	35 12	30 15
DAIRY COWS -									
Ayrshire :									
In Milk ..	56 3	45 5	27 17	60 10	45 17	27 11	60 13	49 2	28 3
Calvers ..	62 5	46 16	30 5	64 10	48 0	31 15	67 4	49 17	32 0
Shorthorn :									
In Milk ...	69 9	53 14	36 4	69 3	55 0	36 3	70 7	54 18	36 5
Calvers ..	67 16	49 17	34 17	65 10	50 3	34 3	67 18	53 10	37 5
STORE SHEEP -									
Cheviot Hogs	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Half-bred Hogs	116 6	84 8	58 0	107 10	97 0	77 5	122 9	82 6	...
Blackface Hogs	149 10	131 10	105 3	105 0	101 3	87 6	...	127 6	...
Greyface Hogs	104 6	86 8	69 8	85 8	65 1	55 9	91 5	69 9	51 2
	97 9	81 8	65 4	115 0	101 3	80 0	95 0
STORE PIGS—									
(6 to 10 weeks old)	79 5	56 3	...	83 11	58 8	...	87 10	66 1	...

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PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH,
AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

Description.	Quality.	September.			October.			November.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF:—		perlb.	perlb.	perlb.	perlb.	perlb.	perlb.	perlb.	perlb.	perlb.
Home-fed—		d.	d.	d.	d.	d.	d.	d.	d.	d.
Bullock or Heifer ...	1	18½	19	18½	18½	18½	18½	19½	18½	19
	2	17½	17½	18	17½	16½	17½	18½	17	18½
Bull ...	1	17½	18½	15½	17½	18	15½	18	17½	16½
	2	16½	17½	13½	16½	16½	13½	17½	17	15½
Cow ...	1	15½	15½	15½	15½	15½	15½	16½	15½	15½
	2	12½	14½	13½	12½	13½	13½	14	14½	13½
Irish—										
Bullock or Heifer ...	1	...	...	17½	17½	...	17½	18½	...	17½
	2	...	...	16½	17½	...	16½	18	...	17
Bull ...	1	...	...	14½	...	...	15½	...	...	15½
	2	...	...	13½	...	...	13½	...	...	14
Argentine Frozen—										
Hind Quarters	1	12	12	12	12	12	12	12	12	12
Fore "	1	8	8	8	8	8	8	8	8	8
Argentine Chilled—										
Hind Quarters	1	...	...	...	...	12	12	...	12	...
Fore "	1	...	...	...	...	8	8	...	8	...
Brazilian Frozen—										
Hind Quarters	1	...	...	...	...	...	...	11	...	...
Fore "	1	...	...	...	...	...	...	...	...	...
Canadian Frozen—										
Hind Quarters	1	...	...	...	...	...	...	12	...	...
Fore ...	1	...	...	...	...	...	...	8	...	...
New Zealand Frozen—										
Hind Quarters	1	...	...	...	...	...	10	...	...	...
Fore "	1	...	...	...	...	...	6½	...	...	...
Uruguay Frozen—										
Hind Quarters	1	...	...	11½	...	...	11½	...	...	...
Fore "	1	...	...	8	...	...	7½	...	...	...
MUTTON:—										
Hoggs, Blackface	under									
	60 lb.	23½	23½	22½	23½	23½	22½	24	23½	23½
	and over.	...	22½	21½	23½	22½	22	23	22½	...
" Cross	under									
	60 lb.	23½	24	22½	23½	24½	22½	24	24½	23½
	60 lb.	...	...	...	...	...	...	...	...	...
	and over.	...	22½	21½	23½	23	22	23	23½	...
Ewes, Cheviot	1	20	21½	20½	19½	20½	19½	19½	19½	19½
	2	19	18½	19½	18½	16	18½	18½	...	18½
" Blackface	1	20	...	...	19½	...	19½	19½	...	19
	2	19	...	19	18½	...	18½	18½	...	18
" Cross	1	20	20½	20½	19½	18½	19½	19½	18½	19
	2	19	18½	19½	18½	16	18½	18½	...	18
Argentine Frozen—	1	...	9	...	...	9	...	...	9	...
	2	...	...	...	...	...	...	...	...	...
Australian "	1	...	8½	8½	8	9	8	8	8½	8½
	2	...	6	6	6	6	6	6	6	6
New Zealand "	1	8½	9	9	9	...	9	8	9	8½
	2	6	6	6	6	...	6	...	6	6
LAMB:—										
Home-fed	1	24½	24½	24½	24½	24½	24½	25½	24	24½
	2	24	22	22½	24	22½	22½	24½	22½	22
New Zealand Frozen...	1	13	13	13	13	13	13	13	13	13
	2	...	...	...	...	...	...	...	...	...

AVERAGE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporter.)

Description.	Quality.	Sept.		Oct.		Nov.		Description.	Quality.	Sept.		Oct.		Nov.	
		s.	d.	s.	d.	s.	d.			s.	d.	s.	d.	s.	d.
BUTTER:								BACON (continued):							
Irish Creamery ... per cwt.	1	446	0	482	6	520	0	American, Long Clear	per	202	0	202	0	202	0
" (Unsalted) "	1	459	0	500	0	535	0	Middles (Green ...)	cwt.	191	0	191	0	191	0
Canadian	1	303	4	336	0	336	0	American, Short Clear		191	0	191	0	191	0
" (Unsalted) "	1	303	4	336	0	336	0	Backs ...	"	191	0	191	0	191	0
Danish ...	1	303	4	336	0	336	0	American, Bellies	"	191	0	191	0	191	0
" (Unsalted) "	1	303	4	336	0	336	0	" Sides	"	190	0	192	0	192	0
Australian	1	303	4	336	0	336	0	" Cumberland Cut	"	187	7	190	0	190	0
" (Unsalted) "	1	303	4	336	0	336	0	Canadian, Sides	"	202	7	203	0	219	3
New Zealand	1	303	4	336	0	336	0	" Cumberland Cut	"	...	...	...	...	...	...
" (Unsalted) "	1	303	4	336	0	336	0	Danish, Sides	"	206	5	208	0	224	6
Argentine	1	303	4	336	0	336	0	HAMS:							
" (Unsalted) "	1	303	4	336	0	336	0	Irish (Smoked)	"	360	0	360	0	360	0
" (Unsalted) "	1	303	4	336	0	336	0	American, Long Cut	"	217	2	218	0	219	9
" (Unsalted) "	1	303	4	336	0	336	0	(Green) ...	"	217	2	218	0	219	9
" (Unsalted) "	1	303	4	336	0	336	0	American, Short Cut	"	...	...	...	...	...	...
" (Unsalted) "	1	303	4	336	0	336	0	Canadian, Long Cut	"	...	...	...	...	...	...
CHEESE:								EGGS:							
Cheddar	1	170	0	169	6	164	0	Country ...	per doz.	4	10	4	11	5	3
"	2	161	10	160	0	154	0	Irish	per 120	4	8	4	9	4	11
Cheddar Loaf	1	180	0	180	0	176	0	"	"	41	7	43	6	50	4
"	2	158	0	157	0	153	6	" (Duck)	"	40	7	42	6	48	9
Dunlop	1	147	7	143	0	137	3	American	"	...	...	...	...	...	...
Canadian	1	163	7	166	0	159	0	Canadian	"	38	11	38	11	40	3
New Zealand	1	156	0	164	4	163	4	Danish	"	...	...	...	...	...	...
"	2	164	6	164	4	163	4	"	"	43	1	44	9	44	6
BACON:								"	"	41	2	43	0	49	6
Ayrshire (Rolled)	1	339	2	332	6	300	6								
Irish (Green)	1	290	0	285	0	262	6								
" (Dried or Smoked)	1	312	0	308	0	284	0								
" (Long Clear)	1	314	5	309	6	293	6								
Wiltshire (Green)	1	290	0	285	9	262	6								
" (Dried or Smoked)	1	313	2	309	6	284	0								

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PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH,
AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

MARKETS.	Quality.	SEPTEMBER.					
		LATE VARIETIES.					
		Second Earlies.	Red Soils.		Other Soils.		
			Lang- worthy.	Other.	Lang- worthy.	Other.	
per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.		
Dundee	First ...	7 0 0	...	...	...	...
	Second ...	6 10 0	...	...	...	...
Edinburgh...	First ...	6 17 6	...	...	...	...
	Second ...	...	...	...	...	...
Glasgow	First ...	8 7 10	...	...	...	...
	Second ...	...	...	...	...	...
OCTOBER.							
Dundee	First ...	7 10 0	...	...	...	...
	Second ...	...	...	...	...	...
Edinburgh...	First ...	7 16 3	...	9 5 0	9 5 0	9 12 6	
	Second ...	...	...	...	...	...
Glasgow	First ...	9 13 3	...	...	...	...
	Second ...	...	...	...	...	...
NOVEMBER.							
Dundee	First ...	7 10 0	...	...	...	7 7 8
	Second ...	...	...	...	...	...
Edinburgh...	First ...	...	...	8 3 4	...	8 3 4
	Second ...	...	...	...	...	...
Glasgow	First ...	10 0 0	9 0 0	...	10 0 0	10 0 0	
	Second ...	...	...	...	...	...

AVERAGE PRICES OF ROOTS, HAY, STRAW, AND MOSS LITTER,
AT DUNDEE, EDINBURGH, AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

SEPTEMBER.											
Markets.	Quality.	Roots.			Hay.		Straw.			Moss Litter.	
		Carrots.	Yellow Turnips.	Swedes.	Rye Grass, and Clover.	Timothy.	Wheat.	Barley.	Oat.		
		per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	
Dundee ...	1	...	50 0	...	192 0	...	156 8	...	...	80 0
	2	...	44 9	...	180 0	...	...	...	...	...
Edinburgh	1	...	...	...	160 0	...	148 9	83 4	130 0	...
	2	...	...	...	143 4	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	70 0
	2	...	...	...	...	...	...	...	...	...
OCTOBER.											
Dundee ..	1	...	35 0	...	195 0	...	...	...	...	80 0
	2	...	28 3	...	180 0	...	...	...	...	...
Edinburgh	1	...	...	...	168 2	...	128 9	80 0	122 6	...
	2	...	...	...	140 0	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	70 0
	2	...	...	...	...	...	...	...	...	...
NOVEMBER.											
Dundee ...	1	...	31 3	30 0	197 6*	...	145 0*	140 0*	160 0*	80 0	
	2	...	24 0	...	177 6*	...	...	...	...	...
Edinburgh	1	...	...	...	169 5†	...	113 9†	84 5†	108 9†	...
	2	...	...	...	123 9†	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	70 0
	2	...	...	...	...	...	...	...	...	...

* Price for Hay and Straw baled and delivered.

† Price for Hay and Straw delivered loose in town.

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	SEPTEMBER.			OCTOBER.			NOVEMBER.		
	Glasgow.		Leith.	Glasgow.		Leith.	Glasgow.		Leith.
	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.
Linseed Cake—									
Home ...	24 6 0	23 18 0	24 0 0	24 0 0	22 16 3	22 15 0			
Foreign ...	23 4 0	...	22 17 6	...	22 2 6	...			
Decorticated Cotton									
Cake (Rangoon)	23 7 6	...	23 17 6	...	23 2 6	...			
Undercorticated									
Cotton Cake—									
Bombay									
(Home-									
manufactured)	14 8 0	12 8 0	13 17 6	12 5 0	11 2 6	10 18 9			
Egyptian									
(Home-									
manufactured)	17 0 0	14 13 0	16 2 6	...	14 2 6	...			
Coconut Cake ...	*16 10 0	...	17 0 0	...	...	...
Palmnut Kernel									
Cake ...	14 7 6	13 7 0	15 5 0	13 15 0	...	13 15 0			
Groundnut Cake ...	†21 10 0	...	...	...	17 13 4	...			
Maize ...	17 11 0	18 10 0	17 0 8	18 10 0	14 16 3	16 5 0			
Bean Meal...	22 16 0	...	22 5 0	...	22 3 4	...			
Locust Bean Meal	15 4 0	15 0 0	15 0 0	...	15 0 0	...			
Maize Meal ...	19 18 0	19 12 0	19 10 0	19 10 0	18 5 0	17 5 0			
Maize Germ Meal	15 10 0	...	14 0 0	...	...	...
Maize Gluten Feed	16 10 0	...	17 0 0	...	...	...
Rice Meal ...	14 13 4	...	14 5 0	...	13 12 6	...			
Oats ...	‡20 4 0	...	‡19 16 3	20 0 0	‡16 16 3	18 0 0			
Barley (Feeding) ...	22 0 0	...	20 15 0	20 0 0	21 0 0	20 0 0			
Malt Culms ...	11 0 0	11 0 0	9 17 6	10 15 0	9 10 0	10 0 0			
Distillery Mixed									
Grains—									
Dried ...	13 8 0	13 12 0	13 0 0	13 0 0	12 11 3	13 0 0			
Wet ...	...	2 0 0	...	2 0 0	...	2 0 0			
Brewers' Grains—									
Dried ...	12 16 0	11 10 0	11 12 6	11 10 0	11 7 6	11 5 0			
Wet ...	...	2 0 0	...	2 0 0	...	2 0 0			
Wheat—									
|| Middlings (Fine									
Thirds or Parings)	15 17 6	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0			
Sharps (Common									
Thirds)...	14 16 3	...	14 10 0	...	14 10 0	...			
|| Bran (Medium) ...	14 17 6	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0			
Bran (Broad) ...	14 10 0	...	...	...	...	...
§ Feeding Treacle ...	15 0 0	14 10 0	15 0 0	14 0 0	...	...	
Crushed Linseed ...	...	...	...	...	...	...
Fish Meal ...	22 14 0	22 10 0	23 15 0	23 0 0	23 11 3	23 10 0			

* Java. † Rangoon. ‡ Plate. ¶ Irish, Black.

| Ex-Mill, bags extra.

§ Nett weight, barrels free.

ACREAGE UNDER EACH VARIETY OF POTATOES IN SCOTLAND (1920),
AS RETURNED BY GROWERS OF ONE ACRE AND OVER.

VARIETY.	Acres.	VARIETY.	Acres.
A. FIRST EARLIES.		C. MAINCROPS.	
1. America	19	32. Abundance (including	
2. Arran Rose	298	Culdees Castle, The	
3. Dargill Early	266	Admiral, The Provost,	
4. Edzell Blue	870	The Crofter, and Fav-	
5. Resistant Snowdrop ...	20	ourite)	3,666
6. Witch Hill	78	33. Arran Victory... ..	950
7. Beauty of Hebron... ..	106	34. Bishop	119
8. Duke of York (including		35. Burnhouse Beauty... ..	56
Midlothian Early) ...	825	36. Dominion	68
9. Dunnottar Castle	7	37. Golden Wonder	4,155
10. Early Puritan... ..	72	38. Irish Queen	128
11. Early Rose	21	39. Kerr's Pink	4,451
12. Eclipse (including Sir		40. Langworthy (including	
John Llewellyn)... ..	1,462	What's Wanted)... ..	2,328
13. Epicure	9,878	41. Leinster Wonder	12
14. May Queen	163	42. Lochar (including Hea-	
15. Myatt's Ashleaf Kidney	23	ther Bountiful)	1,487
16. Ninetyfold	125	43. Majestic	3,184
17. Sharp's Express	623	44. Rector	27
18. Sharp's Victor	149	45. St Malo Kidney	16
19. Snowdrop	21	46. Templar	834
20. Other First Earlies not		47. Tinwald Perfection (in-	
specified above	639	cluding Rob Roy)	4,764
Total First Earlies ...	15,665	48. Arran Chief	29,188
B. SECOND EARLIES.		49. Champion	2,979
21. Arran Comrade	5,228	50. Evergood	1,731
22. Great Scott (including Sir		51. King Edward VII. ...	13,286
Douglas Haig, South-		52. Northern Star	698
ampton Wonder, and		53. President (including Iron	
Conqueror)	16,989	Duke and Scottish	
23. King George V.	5,540	Farmer)	2,485
24. The Ally	2,279	54. Summit	14
25. The Duchess	28	55. Twentieth Century ...	109
26. British Queen (including		56. Up-to-Date (including	
Pioneer)	7,516	Dalhousie Factor,	
27. Conquest... ..	20	Table Talk, Scottish	
28. Queen Mary	215	Triumph, Dalmeny	
29. Royal Kidney... ..	175	Beauty, Dalmeny Re-	
30. Windsor Castle	51	gent, Duchess of Corn-	
31. Other Second Earlies not		wall, and Mayfield	
specified above	2,586	Blossom)	6,726
Total Second Earlies	40,627	57. White City	78
		58. Other Maincrops not	
		specified above	4,249
		Total Maincrops ...	87,788
TOTAL AREA PLANTED ... 144,080 ACRES.			

NOTE.—In the county of *Inverness* the districts of *Skye*, *Harris*, and *North and South Uist* were excluded.

In the county of *Ross and Cromarty* the districts of *South-Western*, *Western* and *Lewis* were excluded.

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ABSTRACT OF AGRICULTURAL RETURNS FOR SCOTLAND, 1920.

Collected 4th June, 1920 (and comparison with 1919).

CROPS.

Distribution.	1920.	1919.	INCREASE.		DECREASE.	
	Acres.	Acres.	Acres.	Per Cent.	Acres.	Per Cent.
TOTAL AREA (excluding WATER)	19,098,683	19,098,683	..	..	..	..
TOTAL ACREAGE under all CROPS and GRASS (a)	4,759,046	4,751,476	..	..	12,429	0·28
ARABLE LAND	3,380,237	3,408,479	..	..	28,242	0·83
PERMANENT GRASS (a) {	152,164	147,679	4,485	8·04	..	..
	1,306,645	1,195,317	11,328	0·95	..	..
	TOTAL	1,342,996	15,813	1·18	..	..
Wheat	54,359	79,509	..	..	25,150	31·68
Barley (including Bares)	204,369	173,746	30,623	17·63	..	..
Oats	1,032,198	1,110,811	..	..	78,613	7·08
Mixed Grain	2,968	1,418	855	60·51	..	..
Rye	6,810	5,815	995	17·11	..	..
Beans (to be harvested as Corn)	5,738	6,654	..	..	928	13·95
Peas	371	370	1	0·27	..	..
Potatoes	162,477	164,590	7,881	5·10	..	..
Turnips and Swedes	426,355	426,451	..	..	1,198	0·28
Mangolds	1,768	2,507	..	..	739	29·48
Cabbage	3,498	3,673	..	..	175	4·76
Rape	14,579	10,752	4,127	38·88	..	..
Vetches or Tares, for Seed	258	318	40	12·58	..	..
Vetches, Tares, Beans, Peas, Mashlum, etc., for Fodder	11,146	12,287	..	..	1,141	9·29
Carrots	315	338	..	..	73	18·31
Onions	168	194	..	..	16	8·70
Flax	1,638	1,001	637	63·64	..	..
Small Fruit	6,370	6,104	166	2·72	..	..
RYE-GRASS and other ROTATION GRASSES and CLOVER {	425,256	394,246	31,010	7·87	..	..
	1,012,574	1,008,888	3,686	0·37	..	..
	TOTAL	1,403,134	34,696	2·47	..	..
OTHER CROPS	1,663	1,870	..	..	7	0·37
BARE FALLOW	6,671	6,896	..	..	225	3·26
ORCHARDS (b)	1,617	1,630	..	..	13	0·80

LIVE STOCK.

	No.	No.	No.	Per Cent.	No.	Per Cent.
Horses used for Agricultural purposes (including Mares for Breeding)	138,251	140,617	..	..	2,366	1·68
Unbroken Horses (including Stallions).	37,533	25,644	1,889	5·30	..	..
	14,792	13,088	1,704	13·02	..	..
TOTAL	190,576	189,949	1,227	0·65	..	..
Other Horses	23,761	23,982	..	..	221	0·92
TOTAL OF HORSES	214,337	213,931	1,006	0·47	..	..
Cows in Milk	350,115	362,096	..	..	11,981	8·31
Cows in Calf, but not in Milk	28,137	44,949	..	..	6,812	15·15
Heifers in Calf	46,237	48,580	..	..	2,353	4·84
Bulls being used for Service	17,724	19,113	..	..	1,389	7·27
Other Cattle :—Two years and above ..	228,149	229,446	..	..	1,297	0·57
" " One year and under two ..	269,187	238,228	..	..	14,041	4·96
" " Under one year	216,173	242,225	..	..	26,052	10·76
TOTAL OF CATTLE	1,165,712	1,229,637	..	..	63,925	5·50
Ewes kept for Breeding	2,756,424	2,826,123	..	..	69,699	2·47
Rams to be used for Service in 1920 ..	77,362	79,603	..	..	2,241	2·82
Other Sheep :—One year and above ..	1,013,512	1,067,603	..	..	54,091	5·07
" " Under one year	2,512,630	2,436,710	76,920	8·16	..	..
TOTAL OF SHEEP	6,360,928	6,410,039	..	..	49,111	0·77
Sows kept for Breeding	14,530	15,084	..	..	504	3·34
Boars being used for Service	1,605	1,672	..	..	67	4·01
Other Pigs	112,374	121,149	..	..	8,775	7·24
TOTAL OF PIGS	128,559	137,905	..	..	9,346	6·78

(a) Excluding Mountain and Heath Land used for grazing (9,507,516 acres in 1920).

(b) Any Crop or Grass grown in Orchards is also returned under its proper heading.

ACREAGE under WHEAT, BARLEY (including Bere), and OATS in each COUNTY on 4th June 1920, with COMPARISON for 1919.

COUNTIES.	Wheat.		Barley (including Bere).		Oats.	
	1920.	1919.	1920.	1919.	1920.	1919.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
ABERDEEN . .	33	16	29,772	23,250	190,938	207,644
ARGYLL . .	...	2	1,751	1,693	18,114	20,194
AYR . .	1,104	2,156	549	496	47,490	51,192
BANFF . .	...	13	9,505	7,480	48,636	52,289
BERWICK . .	3,031	6,817	20,543	17,535	32,073	35,149
BUTE . .	27	45	51	24	5,194	5,293
CAITHNESS . .	...	...	1,196	1,198	31,894	33,278
CLACKMANNAN . .	445	436	266	259	3,507	3,685
DUMBARTON . .	838	975	31	27	8,621	8,797
DUMFRIES . .	116	145	742	631	44,663	50,516
FIFE . .	10,894	15,694	18,031	14,911	47,629	48,639
FORFAR . .	8,995	11,494	22,904	20,586	57,241	61,334
HADDINGTON . .	4,050	7,773	17,702	14,749	18,073	18,929
INVERNESS . .	111	226	6,096	5,139	29,652	31,110
KINCARDINE . .	1,070	1,576	13,091	11,921	30,521	34,162
KINROSS . .	172	337	411	371	8,159	8,283
KIRKCUDBRIGHT . .	21	54	188	219	28,900	33,029
LANARK . .	2,696	3,441	296	345	46,098	48,592
LINLITHGOW . .	2,219	3,203	3,001	2,355	12,114	12,738
MIDLOTHIAN . .	4,539	7,478	7,629	5,696	22,468	23,510
MORAY . .	580	1,001	10,784	9,385	24,629	27,248
NAIRN . .	25	44	2,465	2,142	6,354	7,049
ORKNEY . .	...	...	4,154	4,229	34,603	35,928
PEEBLES . .	...	3	625	412	7,520	8,389
PERTH . .	7,782	8,880	6,480	5,253	77,996	83,394
RENFREW . .	2,073	2,377	80	60	12,331	12,556
ROSS & CROMARTY . .	779	1,371	9,681	8,478	32,769	35,597
ROXBURGH . .	577	1,502	12,354	11,098	28,683	31,852
SELKIRK . .	18	28	479	366	4,607	4,864
SHETLAND . .	...	...	857	900	6,854	7,039
STIRLING . .	2,029	2,284	1,664	1,480	21,240	22,579
SUTHERLAND . .	...	1	623	642	7,850	8,169
WIGTOWN . .	135	137	368	416	34,777	37,784
TOTAL . .	54,359	79,509	204,369	173,746	1,032,198	1,110,811

ACREAGE under BEANS, POTATOES, and TURNIPS and SWEDES in each COUNTY on 4th June 1920, with COMPARISON for 1919.

COUNTIES.	Beans.*		Potatoes.		Turnips and Swedes.	
	1920.	1919.	1920.	1919.	1920.	1919.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
ABERDEEN .	...	20	7,723	7,302	83,959	82,695
ARGYLL .	45	101	3,591	3,828	5,645	6,046
AYR .	473	581	10,504	10,293	7,828	8,594
BANFF .	57	52	1,925	1,829	20,475	20,527
BERWICK .	679	830	2,740	2,576	23,330	22,712
BUTE .	42	53	1,293	1,252	1,286	1,426
CAITHNESS .	...	...	1,413	1,407	11,903	12,087
CLACKMANNAN.	246	294	553	457	770	798
DUMBARTON .	6	56	2,989	2,812	1,415	1,623
DUMFRIES .	40	51	4,962	4,362	16,211	15,630
FIFE .	292	337	18,361	17,438	22,268	21,926
FORFAR .	49	43	18,725	18,297	31,800	31,888
HADDINGTON .	142	138	7,959	7,758	13,502	13,163
INVERNESS .	2	6	5,513	5,328	9,626	9,890
KINCARDINE .	49	35	4,588	4,130	16,213	15,747
KINROSS .	...	9	1,527	1,231	2,542	2,588
KIRKCUDBRIGHT	30	32	1,956	1,736	11,160	11,482
LANARK .	117	149	7,135	6,612	9,810	10,417
LINLITHGOW .	50	65	2,811	2,604	3,264	3,330
MIDLOTHIAN .	16	19	7,456	7,040	9,742	10,004
MORAY .	20	15	1,855	1,829	14,120	14,191
NAIRN .	...	...	288	270	3,895	3,908
ORKNEY .	...	...	2,436	2,444	13,862	13,866
PEEBLES .	...	...	580	490	3,408	3,557
PERTH .	1,097	1,201	21,445	19,813	26,050	26,971
RENFREW .	131	149	3,549	3,460	2,231	2,418
ROSS AND CROMARTY .	2	14	7,364	7,245	14,916	14,833
ROXBURGH .	180	147	1,434	1,321	19,602	19,230
SELKIRK .	...	9	217	188	2,458	2,479
SHETLAND .	...	...	2,330	2,460	1,063	1,096
STIRLING .	1,774	2,014	4,193	3,871	3,968	4,358
SUTHERLAND .	...	...	1,372	1,402	2,767	2,877
WIGTOWN .	187	234	1,690	1,511	14,157	14,094
TOTAL .	5,728	6,654	162,477	154,596	425,255	426,451

* To be harvested as corn.

ACREAGE under RYE-GRASS and other ROTATION GRASSES and CLOVER, and under PERMANENT GRASS in each COUNTY on 4th June 1920, with COMPARISON for 1919.

COUNTIES.	Rye-grass and other Rotation Grasses and Clover.				Permanent Grass.			
	For Hay.		Not for Hay.		For Hay.		Not for Hay.	
	1920.	1919.	1920.	1919.	1920.	1919.	1920.	1919.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
ABERDEEN . . .	50,228	47,544	227,786	225,497	1,289	741	32,541	29,640
ARGYLL . . .	12,403	12,078	16,260	16,460	14,254	13,691	54,849	55,190
AYR . . .	32,926	27,116	46,006	47,183	21,223	21,684	142,016	140,153
BANFF . . .	9,821	9,304	57,491	57,394	377	367	9,820	8,715
BERWICK . . .	11,275	10,427	45,525	44,644	1,892	1,787	46,789	46,380
BUTE . . .	2,529	2,435	4,853	5,146	690	617	9,270	9,026
CAITHNESS . .	10,156	9,905	25,531	25,201	742	703	23,927	23,088
CLACKMANNAN .	1,375	1,303	1,474	1,182	1,323	1,164	5,311	5,572
DUMBARTON . .	6,145	5,811	5,287	5,417	2,011	2,172	19,562	19,445
DUMFRIES . . .	21,351	18,436	44,972	50,030	17,896	18,136	94,233	88,049
FIFE . . .	27,425	25,965	26,830	28,087	2,767	2,757	65,754	66,109
FORFAR . . .	22,502	21,519	58,172	56,538	1,604	1,127	22,285	22,939
HADDINGTON . .	10,631	10,510	14,307	14,393	1,057	529	20,048	19,453
INVERNESS . .	11,797	11,959	19,981	19,877	8,353	7,427	55,317	56,045
KINCARDINE . .	13,155	12,311	31,295	30,435	220	214	8,173	7,846
KINROSS . . .	3,098	2,844	6,268	7,004	689	499	10,319	10,382
KIRKCOUBRIGHT	10,999	8,236	39,569	39,986	11,844	11,644	73,142	73,187
LANARK . . .	34,499	31,659	34,395	35,719	13,554	13,970	95,065	94,258
LINLITHGOW . .	7,613	7,018	4,479	3,640	1,279	1,225	19,683	20,686
MIDLOTHIAN . .	12,504	11,540	14,065	13,695	2,509	2,180	38,191	39,063
MORAY . . .	5,628	5,452	33,116	31,766	243	207	6,775	6,687
NAIRN . . .	1,487	1,540	8,816	8,956	80	26	1,956	1,471
ORKNEY . . .	9,464	9,475	29,062	27,966	374	255	13,790	14,472
PEEBLES . . .	2,821	2,429	10,932	10,681	1,342	1,389	22,450	22,537
PERTH . . .	34,606	32,623	55,459	55,561	11,340	10,955	79,904	79,279
RENFREW . . .	9,973	9,935	6,375	5,919	7,307	6,445	39,853	40,621
ROSS AND CROMARTY .	14,147	13,127	30,713	29,125	2,152	2,518	23,032	24,063
ROXBURGH . . .	9,659	9,051	41,687	40,300	6,906	6,543	54,148	54,565
SHELBURGH . .	1,600	1,314	5,927	6,396	1,858	1,832	12,393	12,165
SHELBURGH . .	1,414	1,388	626	618	1,670	1,619	10,917	11,384
STIRLING . . .	11,983	11,717	9,378	9,096	7,370	6,970	47,754	47,592
SUTHERLAND . .	4,700	4,411	5,316	4,866	1,543	1,621	5,935	6,292
WIGTOWN . . .	5,342	3,864	50,621	50,110	4,406	4,765	41,443	39,943
TOTAL . . .	425,256	394,246	1,012,574	1,008,888	152,164	147,679	1,206,645	1,195,317

NUMBER of HORSES, CATTLE, SHEEP, and PIGS in each COUNTY on
4th June 1920, with COMPARISON for 1919.

COUNTIES.	Horses.*		Cattle.		Sheep.		Pigs.	
	1920.	1919.	1920.	1919.	1920.	1919.	1920.	1919.
	No.	No.	No.	No.	No.	No.	No.	No.
ABERDEEN .	31,032	30,657	170,116	176,625	170,437	184,027	10,362	10,946
ARGYLL .	6,180	5,946	58,162	60,590	776,818	758,604	4,447	4,929
AYR .	10,160	10,177	111,112	114,696	334,242	339,183	11,627	12,130
BANFF .	8,669	8,533	43,740	44,930	55,747	59,935	2,541	2,818
BREWICK .	4,744	4,809	17,689	18,848	297,109	295,362	3,719	3,781
BUTH .	1,327	1,249	9,685	9,649	38,498	39,999	627	807
CAITHNESS .	5,714	5,592	19,990	20,816	123,111	135,982	1,766	1,924
CLACKMANNAN .	749	729	3,369	3,366	13,397	12,962	535	528
DUMBARTON .	1,855	1,842	13,316	14,629	64,512	64,251	1,115	1,189
DUMFRIES .	7,409	7,413	66,199	70,929	515,424	512,907	8,390	9,642
FIFE .	9,501	9,421	40,984	43,622	82,214	91,633	6,090	6,672
FORFAR .	8,803	9,304	44,238	47,806	148,041	149,629	6,238	6,764
HADDINGTON .	3,470	3,499	8,781	8,960	110,941	114,840	1,970	2,085
INVERNESS .	8,137	8,017	47,108	48,935	496,950	494,326	1,578	1,719
KINCARDINE .	4,964	4,997	24,313	25,775	35,239	38,518	1,751	2,255
KINROSS .	1,197	1,146	6,403	6,464	26,294	28,389	687	801
KIRKCUDBRIGHT .	5,125	5,116	54,930	57,161	337,645	338,894	10,908	11,991
LANARK .	8,453	8,490	70,684	75,136	220,560	219,857	7,424	7,532
LINLITHGOW .	2,272	2,246	11,290	11,717	12,086	15,002	1,472	1,086
MIDLOTHIAN .	3,873	3,874	16,374	17,642	160,036	158,530	9,495	10,028
MORAY .	4,956	4,949	21,903	23,089	40,215	44,095	1,561	1,817
NAIRN .	1,308	1,384	6,110	6,704	13,393	15,879	566	531
ORKNEY .	6,512	6,370	31,598	33,463	29,786	33,482	1,306	1,653
PERIBLES .	1,102	1,082	6,786	7,367	192,185	187,309	363	377
PERTH .	12,902	12,919	66,134	71,761	552,309	547,391	7,136	7,725
RENFREW .	3,121	3,104	25,911	27,592	33,532	36,720	2,018	2,021
ROSS AND CROMARTY .	7,023	6,904	39,324	41,774	258,893	266,816	2,569	3,464
ROXBURGH .	4,013	4,071	19,112	20,251	493,277	492,967	2,877	3,247
SELKIRK .	599	598	3,025	3,611	173,245	164,897	427	359
SHEPTELAND .	2,845	2,518	13,498	14,136	140,150	141,746	398	495
STIRLING .	4,756	4,706	29,937	32,934	107,938	110,365	2,239	2,212
SUTHERLAND .	2,123	2,156	10,198	11,156	199,204	202,030	451	553
WIGTOWN .	5,682	5,531	53,693	55,503	107,500	112,512	13,906	13,824
TOTAL .	190,576	189,349	1,165,712	1,229,637	6,360,928	6,410,039	123,559	137,906

* Horses used for agricultural purposes, mares for breeding, and unbroken horses (including stallions). "Other horses" on agricultural holdings are not included; the total of these for Scotland is given in the summary table on p. 1.

ACREAGE OF CROPS AND NUMBER OF LIVE STOCK IN EACH COUNTY DISTRICT OF SCOTLAND ON 4th JUNE 1920.

COUNTY AND DISTRICT OF COUNTY.	Wheat.	Barley (including Bero).	Oats.	Beans.	Potatoes.	Turnips and Swedes.	Bye-grass and other Rotations Grasses & Clover.		Permanent Grass.		Horses.	Cattle.	Sheep.	Pigs.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	For Hay.	Not for Hay.	For Hay.	Not for Hay.	No.	No.	No.	No.
ABERDEEN	7	7,341	17,189	..	1,335	10,043	7,782	24,770	9	2,277	8,571	19,950	6,313	2,687
Aberdeen	1,322	11,027	..	359	7,902	5,000	20,748	151	5,743	2,580	18,085	32,533	525
Baird	3,744	44,231	..	2,151	17,095	11,923	44,760	564	6,323	6,323	37,449	23,239	1,842
Deeside	3,163	14,586	..	481	7,238	5,715	18,313	31	3,645	2,613	14,963	40,336	611
Ellon	4,432	23,926	..	887	12,602	7,322	33,628	103	3,645	2,734	23,966	17,905	1,047
Garioch	4,650	24,220	..	759	11,210	5,400	30,585	233	7,725	4,179	21,523	11,196	1,164
Huntly	1,968	16,040	..	406	6,616	2,322	22,421	22	3,220	2,890	13,333	29,027	1,037
Turriff	3,522	25,710	..	836	11,543	4,914	32,063	176	1,974	4,362	25,133	9,934	1,503
ARDNAMURCHAN	510	..	260	59	627	199	1,207	1,551	167	3,135	65,696	39
Cowal	1,514	..	315	1,112	1,112	1,175	1,502	6,002	409	4,940	143,321	157
Islay	60	4,372	..	638	1,337	3,033	3,398	1,674	17,169	1,242	11,185	80,017	707
Kintyre	893	4,307	45	474	2,227	1,479	8,317	1,004	11,674	1,585	13,790	125,689	2,376
ARISTALL	..	8	2,666	..	782	675	2,700	822	3,966	5,320	933	7,382	165,987	424
Lorn	3	1,932	..	449	577	1,842	1,216	2,411	6,411	627	7,483	111,735	379
Mid-Arghyll	787	2,293	..	673	325	1,610	633	2,311	6,456	1,197	5,483	75,523	363
AYR	..	24	12,293	239	1,927	1,823	8,662	13,394	6,264	38,563	2,418	29,972	100,235	3,883
Ayr	478	11,775	97	4,390	3,035	5,359	11,238	4,338	32,867	2,617	23,940	172,023	2,783
Kilmarnock	14	11,389	77	1,202	1,447	10,147	11,768	6,337	37,447	2,553	31,394	25,544	5,947
Northern	33	11,523	60	2,385	1,523	8,753	9,556	5,234	33,149	2,567	25,906	86,135	1,009
BANFF	..	7,487	27,031	56	1,346	12,065	5,478	33,003	147	2,375	4,935	36,242	13,925	1,324
Keith	2,018	21,905	1	679	8,410	4,343	24,383	230	7,445	3,684	17,493	41,352	717
BELWICK	..	7,952	9,383	242	1,258	7,499	3,895	13,991	146	13,450	1,590	5,136	71,712	1,497
East	9,350	11,031	369	956	8,667	4,389	11,909	1,015	17,565	1,582	7,231	104,374	1,466
West	3,241	11,459	63	526	7,164	2,331	19,625	731	15,774	1,272	5,272	121,123	756
BURNS	..	20	2,502	31	775	426	1,239	2,194	314	4,393	683	4,781	31,127	329
Arran	31	2,692	11	518	890	1,260	2,639	376	4,963	644	4,304	7,371	263
CAITHNESS (Not divided)	..	1,196	31,384	..	1,413	11,903	10,156	25,331	742	23,927	5,714	19,990	123,111	1,766
CLACKMANNAN (Not divided)	..	266	3,507	246	553	770	1,375	1,474	1,523	6,311	749	3,369	13,397	535
DUMFRIES	..	18	4,502	3	1,450	667	3,443	2,325	826	3,694	989	5,961	9,990	689
Eastern	13	4,119	3	1,339	743	2,667	2,952	1,156	10,368	366	7,355	54,552	426
DUMFRIES	..	437	14,143	9	1,693	4,939	6,297	12,588	2,105	16,333	2,250	14,751	40,059	1,936
Annan	1,543	11,343	2	1,641	3,781	4,323	11,390	1,923	13,546	1,561	13,021	43,980	1,783
Dumfries	49	1,543	2	232	1,050	1,022	2,990	3,013	7,846	6,092	6,092	117,963	520
Langholm	13	2,613	..	232	1,050	1,022	2,990	3,013	7,846	6,092	6,092	117,963	520
Lockerbie	224	10,100	27	889	3,934	4,904	11,409	5,071	31,798	1,786	17,709	136,304	2,497
Thornhill	5	6,954	2	631	2,517	4,043	7,296	5,071	31,798	1,266	16,526	178,313	2,497

* To be harvested as corn.

† See Note on p. 5.

ACREAGE OF CROPS AND NUMBER OF LIVE STOCK IN EACH COUNTY DISTRICT OF SCOTLAND ON 4th JUNE 1920.

COUNTY AND DISTRICT OF COUNTY.	Wheat.	Barley (including Bares).	Oats.	Beans.	Potatoes.	Turnips & Swedes.	Eye-grass and Other Rotation Grasses & Clover.		Permanent Grass.		Horses.	Cattle.	Sheep.	Pigs.
	Acrea.	Acrea.	Acrea.	Acrea.	Acrea.	Acrea.	For Hay.	Not for Hay.	For Hay.	Not for Hay.				
FIFE	..	3,657	15,142	13	6,453	7,768	7,441	11,539	332	15,301	2,775	11,151	31,235	1,705
	..	1,206	1,063	130	2,101	2,722	5,004	3,349	1,007	19,911	1,728	9,154	17,458	941
	..	2,215	3,520	4	3,997	4,391	6,873	5,681	910	12,464	2,226	9,218	16,940	1,949
	..	3,816	13,094	95	5,810	7,387	8,107	6,371	518	18,088	2,772	11,461	16,031	1,496
FORFAR	..	3,903	10,140	5	4,300	6,794	4,901	9,905	142	2,908	1,733	7,953	4,948	932
	..	2,029	7,566	36	4,457	9,769	6,884	19,017	342	6,415	2,543	12,724	56,038	1,440
	..	2,643	10,559	8	4,596	6,038	4,653	9,408	364	1,745	9,284	11,632	2,140	1,460
	..	2,130	18,466	..	5,178	9,278	6,194	19,842	766	10,151	2,784	14,377	74,533	1,706
HADDINGTON	..	1,170	6,896	52	3,119	5,137	2,462	5,806	482	8,188	1,227	2,973	55,743	600
	..	2,830	10,316	90	4,340	5,363	7,149	8,501	575	11,560	2,233	5,363	55,163	1,370
INVERNESS	..	4	2,598	7,638	..	4,438	3,211	9,731	190	4,305	1,594	6,641	33,224	608
	..	107	256	6,318	..	2,069	2,069	5,232	423	4,259	1,136	6,327	89,492	212
	135	4,519	..	1,775	2,429	5,892	1,438	8,390	939	4,790	139,276	196
	2	1,379	..	533	1,439	381	2,237	2,442	1,112	3,227	16,403	10
KINCARDINE	4,331	..	1,324	1,324	1,324	1,324	..	1,324	3,108	13,792	61,804	10
	4,467	..	2,306	132	267	111	1,453	31,404	3,108	13,792	61,804	10
	..	438	9,704	2	1,735	4,524	3,304	8,271	94	1,442	1,200	6,478	12,385	436
	..	1,508	3,493	..	750	1,794	2,057	3,231	80	390	663	3,106	7,407	301
KIRKCUDBRIGHT	..	2,899	5,764	20	1,089	3,139	2,693	5,171	43	2,475	1,882	2,649	7,407	301
	..	123	3,665	27	1,321	2,410	1,432	6,168	3	1,536	1,432	2,649	7,407	301
	..	1,925	5,367	..	233	2,246	1,590	4,468	..	1,336	612	4,274	6,439	291
	..	173	411	..	1,527	2,542	3,068	6,268	689	10,319	1,197	6,403	26,234	687
LANARK	..	1	11,998	8	1,990	4,355	4,009	14,834	3,103	22,904	1,918	13,689	57,596	2,885
	..	20	11,234	..	4,410	3,833	4,157	19,376	4,310	39,751	2,190	13,689	180,044	70
	2,656	13	113	4,921	4,157	19,376	4,310	39,751	2,190	13,689	180,044	70
	..	17	2,656	..	113	1,021	2,625	2,625	1,274	9,033	478	5,538	77,132	660
LEITH	..	51	4,312	9	1,631	607	3,796	1,713	2,374	6,057	965	4,554	715	2,818
	..	1,607	20,357	108	2,677	3,425	18,656	12,368	5,067	46,881	4,019	35,795	92,885	2,067
	..	47	20,429	..	2,827	5,777	12,047	20,374	5,067	42,127	3,470	30,335	193,430	1,739
	..	293	5,927	16	2,103	1,068	3,818	2,705	743	12,408	1,119	6,747	4,875	457
MID-LOTHIAN	..	1,961	6,187	34	2,103	2,166	3,795	1,774	536	7,275	1,153	4,543	7,211	1,035
	..	1,188	6,162	..	2,082	1,648	4,030	2,212	650	12,796	1,164	6,345	31,669	1,181
	..	1,180	6,237	..	2,082	1,648	4,030	2,212	650	12,796	1,164	6,345	31,669	1,181
	..	2,149	4,039	..	2,082	1,648	4,030	2,212	650	12,796	1,164	6,345	31,669	1,181
MORAY (Not divided)	..	880	10,784	20	1,855	14,190	5,628	33,116	243	6,775	4,966	21,908	40,215	1,461

† See Note on p. 5.

* To be harvested as corn.

ACREAGE OF CROPS AND NUMBER OF LIVE STOCK IN EACH COUNTY DISTRICT OF SCOTLAND ON 4th JUNE 1920.

COUNTY AND DISTRICT OF COUNTY.	Wheat. (Including Bere).	Barley (Including Bere).	Oats.	Beans. Acres.	Potatoes. Acres.	Turnips and Swedes. Acres.	Rye-grass and other Rotation Grasses & Clover.		Permanent Grass.		† Horses.	Cattle. No.	Sheep. No.	Pigs. No.
							For Hay.	Not for Hay.	For Hay.	Not for Hay.				
NAHAR (Not divided)	Acres. 25	2,465	6,364	..	Acres. 298	3,895	1,487	8,816	80	1,968	1,806	6,110	13,898	596
ORNEY { Mainland	1,813	1,813	19,891	..	1,273	7,136	5,684	10,475	261	7,396	2,620	16,656	11,289	672
North Isles	2,479	2,479	10,210	..	801	4,814	2,686	10,049	86	5,333	1,087	13,508	13,508	897
{ E. Highlands & Walls ..	..	362	5,002	..	367	1,912	1,234	2,538	88	1,061	742	4,906	5,042	107
PARRIES (Not divided) .. .. .	..	625	7,620	..	580	3,408	2,821	10,032	1,842	22,460	1,108	6,798	192,186	368
PERTH { Blairgowrie	2,155	2,755	16,675	4	5,696	6,987	6,847	14,838	342	10,961	2,827	12,892	40,690	1,667
{ Central	776	369	17,843	19	4,885	4,889	7,809	12,227	1,656	16,917	2,781	12,638	115,000	1,469
{ Highland	29	2,802	24,033	185	1,089	2,908	4,746	6,161	2,298	13,568	1,610	9,647	186,403	929
{ Western	4,823	2,802	11,579	580	2,492	2,206	10,061	16,664	2,177	17,743	2,719	17,472	42,344	2,520
RAVENHAW { First or Upper	1,287	38	6,501	33	1,482	1,035	4,731	2,901	4,000	20,407	1,408	12,812	14,917	878
{ Second or Lower	786	47	6,880	98	2,067	1,196	5,242	3,774	3,247	19,446	1,718	15,009	13,615	1,140
ROSS & CROMARTY { Black Isle	10	2,931	7,445	..	767	4,248	3,419	8,808	43	912	1,617	5,790	8,713	898
{ Black Ross	735	2,323	10,483	..	1,767	5,319	4,563	10,060	361	5,387	1,067	6,067	84,043	1,047
{ Mid Ross	34	2,044	9,604	2	812	4,619	4,593	9,694	418	5,287	1,367	5,092	5,092	567
{ S. W. and Western .. .. .	..	30	1,903	..	795	226	1,703	420	1,218	2,189	861	5,047	78,109	64
{ Lewis .. .. .	..	2,358	3,294	..	3,647	172	160	115	168	9,408	1,226	11,462	53,567	2
ROXBURGH { Hawick & Liddesdale	10	197	8,979	..	215	2,209	1,588	4,878	3,508	12,630	628	5,084	169,601	644
{ Berwick	124	2,532	9,400	33	830	5,011	2,777	13,635	1,673	16,043	1,848	5,895	188,038	806
{ Kelso	304	1,766	6,406	161	222	3,902	1,941	8,324	860	12,367	1,773	2,876	127,111	1,094
{ Melrose	140	..	..	6	..	..	..	..	..	..	..	..	67,582	473
SHARFIRE (Not divided)	13	479	4,607	..	217	2,453	1,600	5,927	1,868	12,868	569	3,025	173,245	287
SHEPHERD { Mainland .. .. .	..	890	5,502	..	1,876	915	1,079	529	1,168	8,385	1,790	10,263	111,884	322
{ North Isles .. .. .	..	37	1,332	..	454	143	579	97	507	2,582	1,066	2,235	25,766	176
STEARLES { Central	886	866	8,540	1,016	1,731	1,711	4,290	3,885	4,198	15,901	2,065	11,742	24,498	921
{ Eastern	967	772	7,013	732	1,038	1,228	4,056	2,218	1,624	15,266	1,388	8,189	8,555	774
{ Western	196	86	5,687	26	1,424	1,029	3,697	3,276	1,563	16,687	1,308	10,098	68,335	844
SUTHERLAND (Not divided) .. .. .	..	623	7,860	..	1,373	2,767	4,700	5,316	1,543	5,965	2,128	10,198	199,304	461
WIGGON { Mearns	109	247	14,726	169	422	5,697	3,642	19,717	3,098	27,302	2,649	25,139	58,257	4,296
{ Rhins	26	21	20,051	18	1,268	8,490	1,800	39,304	1,408	14,141	2,083	22,564	51,243	9,698

* To be harvested as corn.

† See Note on p. 5.

BOARD OF AGRICULTURE FOR SCOTLAND,
29 ST. ANDREW SQUARE,

The ~~Scottish~~ Journal of Agriculture.

VOL. IV.—No. 2.]

APRIL 1921.

PRICE 1s. NET.

THE FARMING OF NATIONAL LAND

THE RIGHT HON. LORD ERNLE, M.V.O.

FEW Englishmen have that familiarity with Scottish farming which would enable them to write on the subject without blundering. I am not one of those few. It is a compliment to be asked to write for *The Scottish Journal of Agriculture*. The flattery soothes my vanity; it does not drug my caution. Real farmers are keen to detect, and slow to forgive, the mistakes of those who presume to write on the practical details of their industry. I have therefore thought over and rejected many possible subjects before selecting that of "The Farming of National Land." No doubt the nationalisation of land is a political question. From some points of view it is also a moral question. It involves a number of issues which are highly controversial. It raises serious financial problems. None of these points are discussed. I confine myself strictly to the business aspects of the question as they affect the position of occupiers of land. Thus narrowly restricted, the subject has a practical importance to the agricultural community which will, I hope, justify its discussion in the pages of this Journal.

Landowners and tenant-farmers ought to have before their minds the proposals that are made, and to form an opinion on their probable effect if applied to their industry. So far as agricultural land is concerned, their knowledge and experience should be valuable and influential. They are the men who know. Their opinion is the more necessary in view of the recent statement by the President of the National Farmers Union that, in certain events, tenant-farmers might join in the demand for nationalisation. It is essential that agriculturists should know whether that road leads, and where it will land them. Nationalisation cannot safely be labelled revolutionary and then pigeon-holed as something incompatible with that ordered progress which characterises the history of the nation. Prudence suggests that agriculturists should rather regard it as a measure which may be carried out by constitutional methods, with due regard to honesty and justice. They cannot afford to ignore the proposal or refuse to examine it because, in their opinion, it turns society upside down. They must have reasons for their support or their opposition. Let it be assumed, therefore, that the advocates of nationalisation honestly believe that land can be put to more effective use under State ownership than under private ownership, and that they mean to buy out the existing owners on fair and reasonable terms. By

what means will tenants of national land be selected? What will be the nature of their tenancy? How will rents be fixed? What control will be exercised over cultivation? What would, in fact, be the position of tenant-farmers under the new universal landlord?

These questions are to some extent answered in a draft Bill "to abolish private property in Land and to make it National Property." It is put forward not by the extremists but by those who claim to be moderates. It is, I am informed, to be introduced by them in Parliament during the next session. I do not take this Bill in order to turn it into ridicule. It is obviously a tentative proposal to which even the authors would not bind themselves. I use it as a text because it puts the theory of nationalisation into a concrete form. It brings out some of the difficulties inherent in the change. It indicates the direction in which the minds of those who support the proposal are turning, and the attractions that the change is supposed to offer to those to whom they appeal. It exonerates me from the suspicion of fathering upon advocates of the measure projects for which they are not themselves responsible.

From and after the date on which the Bill becomes law, all land in England, Scotland and Wales is to become "inalienable national property," and all holders of it will pay to the public authorities an annual rent for its use. It is at once obvious that, though the Bill transforms all land into national land, it is not, as drafted, applicable to Scotland. No provision is made, for instance, for the representation of Scotland on the bodies to be established, nor do the local authorities in England who are made responsible for the administration of land exactly correspond under the same names with those in Scotland. No attempt, again, is made to deal with the special cases arising out of the leasehold system which has saved Scotland from some of the difficulties that have arisen in England. The general principles are, however, identical for both countries, and therefore are applicable with the necessary substitutions.

The supreme control is vested in a Ministry of Lands, with which is associated an Advisory National Land Council. On this latter body, consisting of ten members, the National Farmers Union and the National Agricultural Workers Union are each to have one representative. The actual administration of the national land is decentralised. Within their respective areas, subject to the regulations prescribed by Parliament or the Ministry of Lands, it is to be administered by local authorities. The London County Council, the councils of county boroughs and of boroughs other than metropolitan, urban district councils, and rural district councils are each to appoint special committees called *Public Land Committees*, which will have power to co-opt members from outside to the extent of one-fourth of their number. It is important to notice that the ultimate destination of three-fourths of the rent is the local authority for the district. The Public Land Committees are, therefore, the representatives not only of the rate-payers, but of the spending authority.

Whether land is owned by the State or by private individuals, there must be selection of the occupiers. It is to the Public Land

Committee for the area in which the land is situated that every application is to be made for the use of national land. They decide, finally, and without appeal, whether or not the application is to be granted. A register is to be kept, always open to public inspection, in which are entered the name of each tenant and the amount of his annual rent. The note appended to this clause in the Bill shows that the authors are alive to the dangers of their proposal :

“The utmost publicity is necessary in order to avoid even the suspicion of favouritism or corruption, which naturally arises when essential information is withheld from the community in general.”

The remedy is, it may be suggested, totally inadequate as a safeguard against the possibility of grave scandals. That there is scope for favouritism—personal, social, political, denominational—remains undeniable, although the land becomes national, and the selection rests with a committee instead of with an individual. The danger is certainly not removed by the mere publication of the name of the accepted tenant and the amount of his rent. These two facts are not the “essential information” which affords any protection against favouritism. Another difficulty might, and to some extent must, arise. The Committee will, presumably, satisfy itself of the financial stability of each applicant. It is one thing to produce evidence to a private landlord or his agent. It is another, and a very different thing, to produce it before, say, six local tradesmen and two co-opted members. No doubt the inquiry would be “all among neighbours” and it would be quite inconceivable that a butcher or a baker should curtail a customer’s credit because of the information which he has received as a member of the Public Land Committee. But we are all conscious of a certain sensitiveness with regard to our private affairs. It may be that in Scotland farmers are as ready to part with their pass-books as with anything else. It may be that there, as elsewhere, reticence is pushed to the verge of secretiveness. It may be that the reluctance to divulge bank balances is a national prejudice which requires to be overcome as fatal to the establishment of credit banks on the Continental system. Anyhow the feeling exists. But if, on other grounds, nationalisation is really worth having, agriculturists must in this respect put their pride in their pockets.

Assuming that an applicant has satisfied the Public Land Committee, that he is accepted as a suitable tenant, and that his name and rent are duly entered in the public register, he takes possession of his holding. He becomes the tenant of a portion of national land. The Bill provides that he shall “enjoy security of tenure and freedom from disturbance.” The security is not absolute. It is necessarily subject to conditions. The tenant must carry out the terms of his lease or agreement, including, of course, the payment of his agreed or revised rent, and he must be prepared to surrender possession whenever the Public Land Committee decide that it is to “the public advantage” that he should do so, “as, for instance,” if he does not farm the land properly, or if the Committee require the land “for its own or any

public purpose or for the subdivision or amalgamation of holdings." Subject to rights of public resumption, of which the cases enumerated are stated to be instances, the tenant enjoys security of tenure. He also enjoys a new privilege, though it is restricted in character. He may not sublet his holding ; but he may assign it to a stranger, or bequeath it to a member of his family, provided that the Public Land Committee approve the assignee or the heir as suitable tenants of national land. The rent which the tenant contracts to pay is fixed by the Public Land Committee as the representatives of the local authorities, who have the spending of three-fourths of the rent of the land in their area. It is subject to revision every seven years by the same Committee ; but if the tenant is dissatisfied with their revision, he can appeal to a Fair Rent Court. If still dissatisfied he can, presumably, throw up the holding and claim compensation for the resultant loss.

In the transfer of agricultural land to the State are included all buildings and improvements. They become part of the national property. But the tenant may, if he likes, buy them "at a fair valuation." In that case they will form part of his tenant-right, and in any change of tenancy shall be taken over "at a fair valuation," together with any other improvements that he himself may have effected, by the incoming tenant or, alternatively, by the Public Land Committee. A distinction is thus drawn between the land and the equipment which enables it to be cultivated. The land remains the inalienable property of the State ; the improvements may become the property of the tenant.

As a theory the nationalisation of agricultural land may seem simple. The practical application is less easy. The clauses that have been analysed are those which deal with the occupation of agricultural land. From them tenant-farmers can form an opinion of the position which they would hold if agricultural land were nationalised. Whether the framework of this particular Bill were adopted or not, the difficulties which it attempts to meet are those that will require solution, whatever may be the precise form which legislation takes. It will perhaps be useful to examine the present proposals in further detail. The authors of the Bill claim that it saves tenant-farmers "from arbitrary interference by irresponsible private owners." The claim is so far justified that the Bill sweeps away all personal relations between landlord and tenant, and substitutes for the private owner the general body of rate-payers and tax-payers. The fact should be borne in mind throughout.

The first point is security of tenure. In a Note the authors of the Bill emphasise the importance of security. It is, they say, "one of the chief incentives to industry," and they state that it is their purpose "to give to every State tenant as nearly as possible the security which is now enjoyed only by freeholders." How far that purpose is attained tenant-farmers must decide for themselves. I do not myself think that, under any conceivable form of State ownership, any higher degree of permanence than that which is conferred by the Bill can be guaranteed to State tenants. Obviously, no tenancy can be so secure as a freehold, and by destroying private ownership the Bill admittedly weakens "one of the chief incentives to industry." Nor does the new system of

State tenancy appear to strengthen, in any substantial degree, the position which tenant-farmers hold under private landlords. At present the good farmer, who does his duty by his land, may make his occupation as long or as short as he pleases. While human nature is what it is, self-interest will remain a powerful motive. It is the direct interest of all landlords to keep a good tenant. He is not so common, or at all events so universal, that any estate would part with him willingly, to say nothing of the pecuniary loss that any change of tenancy inflicts upon the landlord. What he has chiefly to fear is the compulsory acquisition of some of his land for small holdings, or the sale of the estate. The last-named danger is removed by nationalisation. This change is the one substantial benefit which State ownership would confer on tenant-farmers. But against this added degree of security must be set the increased liability to disturbance both for the creation of small holdings and for the extended range of purposes for which the Public Land Committee may resume possession of the land.

Apart from reasons of "public advantage," for which tenants may be dispossessed of their holdings, they may also be deprived on grounds personal to themselves. A tenant may, for instance, be turned out because he is not, in the opinion of the Public Land Committee, farming the land properly. Apparently the eviction may be quite summary, and allows of no appeal. Under the drastic provisions of the Corn Production Act, designed for the rapidity of action necessary in a war emergency, tenant-farmers were liable to a similar penalty. In the Agriculture Act, intended for peace administration, milder methods are adopted. Nor is the change in the constitution of the tribunal which will wield this formidable weapon of summary eviction without opportunity of appeal altogether favourable to agricultural tenants. Under the Acts of 1917 and 1920 the county agricultural committees are the judges, and up to the present they have contained a preponderance of men of practical experience among their members. Under the Nationalisation Bill the directors, the judges and the executioners are the Public Land Committees, formed of borough or urban or rural district councillors who may or may not be experienced agriculturists. As a fact, no doubt, the bulk of agricultural land in England is within the area administered by rural district councils who are more or less familiar with agricultural conditions. But there is little room on the tribunal for experts or men of science. Their voices are made ineffective. Only one-fourth of the Committee may be brought in from outside by co-option.

The periodical revision of rent adds an additional insecurity to the holding. On the other hand, it is obviously absurd that the rents should be permanently fixed. Changed conditions might make them onerous or nominal. Whatever form legislation may take, rents will have to be revised. The Bill proposes that they should be adjusted every seven years to "such fluctuations, if any, in the value of land as are not due to improvements effected by the tenant." A note lays down the principle that revisions should not be so frequent as "to cause uncertainty and to shake confidence or prevent enterprise." A septennial revision, though it

would come as a shock to many sitting tenants, may be defended as a not unreasonable compromise which can be supported by precedent. The rent is, in the first instance, fixed by the Public Land Committee. Where the tenant has not bought the buildings and improvements, and they, therefore, remain the property of the State, he pays rent for their use as well as for the use of the land. Apparently they will be separately charged, since an appeal is allowed against either one or both of the items of which the rent is composed. At the end of seven years the rent is revised by the Public Land Committee: but an appeal lies against the revision to the Fair Rent Court. The constitution of this appellate tribunal is not explained. Nor are we told whether there will be one or several. As all the tenancies begin on the same day, the date for the septennial revision is also identical, and if appeals are to be promptly settled it is probable that a considerable number of tribunals will be necessary. On the other hand, there may be few appeals. It is sometimes alleged that tenants prefer to acquiesce in unjust decisions by their landlord rather than risk his displeasure by a protest. Precisely the same choice is forced on tenants under this or any other scheme of nationalisation. However good their case may appear to them to be, tenants of national land may hesitate to attempt to set aside the decision of their Public Land Committee. Whether they succeeded or failed, they would be marked men. It is not impossible that they might think it imprudent to alienate a body which controls their cultivation, can evict them either for improper use of their land or on the allegation of "public advantage," and can exercise a veto on their assignees or heirs. In that case the appellate tribunals may be decorative and few. But if they are to be used they must be numerous and expensive.

Scotland is familiar with the working of judicial rents. We do not know them in the south. I should imagine that a tribunal, deciding between landlord and tenant, would show a natural tendency to favour the small man, and would incline to reduce rents and wipe off arrears whenever the opportunity arose. Whether Scotland has had experience of this tendency to vicarious generosity at the expense of a third person, I do not know. But if land is nationalised, I think that the tendency will disappear. It is more likely to veer in the opposite direction when tax-payers and rate-payers, and not a private individual, are the landlords who will have to foot the bill. As has been said, three-fourths of the rent ultimately go to the local authorities in whose area the land is situated, presumably in relief of rates, and it is those public bodies who select, and are represented by, the Public Land Committees. It is therefore improbable that tenant-farmers will be, on any lavish scale, excused arrears, or receive remissions or reductions of rent from the rate-payers' representatives. Whatever may be the fate of the small tenants of national land, it is possible that the fate of those who are tenants of large areas will not err on the side of leniency. They are as likely as not to receive short shrift. The authors of the Bill plainly recognise this possibility. In a note they say "it is undesirable that the authority which has the spending of the rent should have the decisive voice as to what

the rent should be." So it is. But recourse to the Fair Rent Court, which the Bill offers as the only remedy, may land the appellant in worse difficulties. In the draft Bill, it may be added, the remaining fourth of the rental is ultimately paid to the National Exchequer.

It would be interesting to know whether tenants will be free to surrender their holdings at any intermediate period between the septennial revisions. If I understand correctly the effect of Scottish land legislation for a limited class of holdings, the present position is this. "Landholders" are only bound as yearly tenants. They can throw up their holdings by giving a year's notice to the landlord. "Statutory small tenants" cannot quit their holdings when they please, but are bound to remain for the term fixed by the Land Court, and during that period, usually seven years, cannot have their rents revised. If the tenant buys the buildings and improvements, he will be, on the analogy of the Scottish law, a landholder; if he does not buy, he will be a statutory small tenant. Whether the distinction will be preserved or not, we are not informed. The Bill does not state whether the tenant will be bound to the holding for the septennial period, or can throw it up at any time. The point is one of considerable importance, especially in England where tenants sacrifice the certainty of leases in order to retain their freedom to surrender their holdings at their own convenience. One thing seems certain, so far as the Bill under discussion is concerned, and that is that a crofter will be worse off if the land is nationalised. At present he can leave his holding to any member of his family by will, and in default of any bequest the right to the permanent tenancy passes to his heir-at-law. Of this privilege he is deprived, because it rests with the Public Land Committee to decide whether or not they will accept his heir as a suitable tenant.

The tenancy of national land does not promise to be so secure as to tempt the tenant to buy the buildings and improvements. He is accustomed to a valuation at entry and at the close of his tenancy. But he will have much more at stake than residual values, if he owns the buildings and improvements. He will run heavy risks on fluctuations in the cost and consequent value of buildings, and on the possibility of sanitary legislation which may at any moment render them obsolete. Nor is he likely to forget that he is not free to sell his tenant right to the best advantage. The Public Land Committee can interpose its veto on the man of his choice. He might be tempted to buy, if attractive terms were offered; but this would mean a depreciation of the property of rate-payers and tax-payers for the benefit of an individual. It seems at least as probable that an attempt might be made to compel him to become a purchaser by charging a very high rent for the use of buildings and improvements. No one can predict with certainty the extent to which holders of national land will buy its necessary equipment. The most that can be said is that some may and some may not become purchasers. The possibility must therefore be contemplated that, in a proportion of cases, the Public Land Committee must become responsible for the maintenance of the national buildings and improvements. The

prospect widens and the difficulties increase. The existing practice of rating will require complete revision and readjustment. Apart from this complicated and intricate subject, practical questions arise with regard both to buildings and improvements. Will the Committee undertake the duty of themselves deciding what repairs are in each case necessary, or will they rely on an experienced staff? Will they do their own repairs by means of a clerk of works and a building yard? Or will they contract with a builder? In the latter case, at all events, further entries will be required in the register, always open to public inspection, which is the safeguard against favouritism. The whole question of repairs to the State property bristles with complications which do not make either for promptitude or economy. If land nationalisation is not necessarily the best road to a millennium of agricultural prosperity, it certainly seems to afford easy access to a paradise of officials. A fresh set of difficulties arises over improvements. The use of the word begs a large question. Expenditure may be heavy, but the outlay may not be an improvement in the sense of increasing the letting value of the land. It is true that the brunt of the risk falls on the tenant. But he does not bear the whole. The national land may be made, by the tenant's expenditure, less attractive as a business speculation. In that case rate-payers and tax-payers suffer. Are tenants to be controlled in their expenditure? Presumably they must be restricted, and the control will be exercised by the Public Land Committee. If so, there is no new degree of freedom conferred by the Bill, and no approximation in this respect to freehold tenure.

One other point may be mentioned. It very directly affects the cultivation of the soil, and it is a question over which I must confess myself to be honestly puzzled. The authors of the Bill for land nationalisation uphold the equal right of access to the land which is alleged to be inherent in every man. To the vindication of this principle they attach supreme importance, and they protest with fervour against the power of private individuals to appropriate the column of light and air which descends on every given area of land. I do not propose to discuss the theory, or the argument that is based upon it. I wish only to test its application in the present Bill, which aims at giving to every selected tenant of national land as nearly as possible the same security of tenure as a freeholder. Vague phrases are always dangerous. From reading the Bill I should conclude, and I think that I am intended to conclude, that the limitations to the holder's uses of his allotted area are those, and only those, which are set out in the Bill and which have been already discussed. But apparently he has also to give every man access to his land who desires to enjoy his particular column of light and air. If the general public are to be deprived by the Bill of their inherent birthright, they gain in this respect nothing by nationalisation. All that they obtain from the measure is the right to apply for land, a right that they already possess. Freedom of access must mean more than this, or it is something of a mockery. On the other hand, no man in his senses would grow a crop, if he were not allowed to protect it against trespass. Every arable farmer would hesitate to grow corn if in

July the general public might play kiss-in-the-ring in the centre of his crops. But the point is too serious for jest. It really looks as if either the public or the tenant was being fooled. One of the arguments for nationalisation which is most strongly urged by its advocates is this alleged birthright of free access to all land. It is incompatible with arable farming. Either the argument, or the plough, as well as the spade, must be abandoned. The two are inconsistent; they are mutually destructive. It would be a quibble to say that the right of access is preserved because the rent of land goes to the rate-payer and is denied because it goes to a man who has inherited the land or bought it for cash. Before any tenant-farmer applies for an arable or mixed holding of national land, the point should be settled. Otherwise ruin stares him in the face.

Some of the more obvious points of difficulty which are raised by the Bill, so far as it refers to agricultural land, have been dealt with; others will occur to every practical agriculturist. It is not suggested that, in this particular Bill, the difficulties are met in the only possible way. But though some of them may not be insuperable, they are all inseparable from the case. They must necessarily arise whatever form nationalisation takes. They leap to the eye as soon as the project emerges from a cloud of vague phrases into any definite shape, and passes from an abstract social theory into a concrete legislative proposal. The mere outline of the Bill must, I think, convince agriculturists, as practical men of business, that they are vitally interested, on every side, and at every stage of their industry, in any proposal "to abolish private property in Land, and to make it National Property."

COMMON WEEDS¹

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III.—ANNUAL WEEDS WITH RED OR BLUE FLOWERS.

THIS group includes annual weeds with flowers not yellow (Group I.), nor white (Group II.), nor greenish (Group IV.). No hard-and-fast line can be drawn between red and blue flowers, since they are connected by intermediate tints, even on the same plant.

Red Weeds or Polygonums.—The more common red weeds belong to the order Polygonaceæ. The docks and sorrels, species of *Rumex*, are perennials dealt with in their own section. The genus *Polygonum* includes three very common annuals: knotgrass, red-shank and black bindweed.

Knotgrass or Red-weed (*Polygonum aviculare*) has many local names, often indicating the red colour or the wiry, knotted habit of growth. The seedlings are erect, with two seed-leaves and fairly large oblong leaves; the plant is therefore not a true grass. Numerous branches arise later and spread in all directions, trailing along the ground without rooting, or held up amongst the corn.

¹ This is the second instalment of this article, which will be followed by articles dealing with other farm pests.

Sometimes the trailing shoots are thin and wiry with small oval leaves quarter of an inch long, or they may be more succulent with leaves up to two inches long, hence several varieties have been recognised. The great abundance of this weed can be seen in



FIG. 8.—*Left*, KNOTGRASS OR RED-WEED. *Right*, BLACK BINDWEED.
(*Common Weeds*, H. C. Long.)

stubble fields, which are tinged reddish brown by the withering stems. The flowers are not conspicuous, being grouped closely at the bases of the leaves (Fig. 8), and it is only on closer inspection that the prolific seed production is seen. An examination of threshing mill tailings from a crop infested with this weed will

confirm any doubts as to abundance. The seeds or fruits are triangular. They may be found with the membraneous pink-tipped perianth still adhering, or if more heavily screened, as in grasses and clovers, this covering is removed and the fruit is dull brown, not shiny like dock, which is about the same size. The seeds are long lived under grass, and knotgrass is one of the first weeds to



FIG. 9 — REDSHANK OR PERSICARIA.

(a) and (b) Young and older seedlings, (c) and (d) Flowering plant, (e) Groups of flowers.

(*Common Weeds*, H. C. Long)

appear after a farmyard manure heap has been removed, while seedlings may be seen arising from the spread manure. Its success as a weed in corn crops is due to the early and vigorous seedlings, which are well rooted and flowering before being covered over by the taller corn. Young seedlings are easily uprooted by cleaning operations, but older plants with trailing branches will resist cleaning, because the wiry branches simply slew round before the implements, or, if they are stripped off, the crown remains rooted and sends out new branches. Knotgrass does

not flourish amongst grasses, except about gates and bare places.

Redshank, *Persicaria*, or Willow-weed (*Polygonum persicaria*) is distinguished by its more erect growth, deep red swollen stems, and leaves with a central dark blotch (Fig. 9). The flowers are massed at the ends of branches, into clusters, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long. The coloured perianth of the flowers may be pink or purplish, and it often persists round the fruit as a brown membrane. The fruits are shiny black, mostly flattened, but some are roughly triangular, about $\frac{1}{16}$ inch diameter. The covered or naked fruits are very abundant in the mill screenings of many farms. According to the Rothamsted observations, redshank is often irregular in its distribution in the same field; where it occurs the ground is usually damp, either from emerging springs, leaky drains or surface water. As a weed it is frequent on peaty and acid soils, and is not so abundant on basic soils, so that its occurrence suggests application of basic manures or need of improvement of drainage. The seeds survive in rotting farmyard manure, which may account for the frequency of redshank on highly manured soils. The plant is easily uprooted in the cleaning of root crops.

Black Bindweed (*Polygonum convolvulus*) is not distinctly a red-weed, but it is better dealt with here with other polygonums. It resembles in its leaves and twining growth the true convolvulus bindweed (*Convolvulus arvensis*), but black bindweed is an annual with a simple root system, and its small flowers (Fig. 8) are very different from the large pink convolvulus flowers, 1 inch in diameter. The seedlings may be found in any crop, but it is in corn that the plants attain full growth, twining round the corn plants and interfering with plant nutrition by the leaves. Flowering begins on young plants and continues up till harvest, so that fruits are ripened and drop to the soil during most of the time the corn is on the land. The fruits are sharply triangular, $\frac{1}{8}$ inch, distinctly larger than those of docks or knotgrass, and more similar to true buckwheat. They are brown if still enclosed in the remains of the floral perianth, black if this is removed, and sometimes white, when the single true seed escapes from the black fruit-husk. Cereal grain often contains the fruits of black bindweed as an impurity, and they may be abundant in threshing mill screenings. They are largely used in poultry food mixtures, and appear to be suitable for this, though they have been reputed poisonous to farm stock; they are certainly eaten by wild birds. Clean seed corn will do much to reduce black bindweed in corn, if surface cultivation is vigorously carried on in the root crops.

Hemp Nettle or Day Nettle (*Galeopsis*).—This is a common weed in Scotland, more so than in England. The plant is nettle-like, and though it lacks the characteristic stinging hairs of the true nettle, it has prickly hairs that break off in the skin, causing distinct irritation. We have seen serious cases of blood-poisoning attributed to handling oat sheaves containing hemp nettle. The stems are square, with large opposite leaves, and the upper groups of flowers are conspicuous above the corn. The flowers are irregular two-lipped, and arise in groups characteristic of the order Labiatae (Fig. 10); one species, *Galeopsis tetrahit*, has the

petal tube about $\frac{3}{4}$ inch long, varying in colour from purplish to white. *Galeopsis versicolor*, a variety, has longer pale yellow petals with a purplish blotch on the lower lip. Red hemp nettle (*G. Ladanum*) is a smaller plant, softer to the touch, with red or rosy flowers. Four seeds or nutlets remain in the persistent calyx of each flower after the petals have fallen (Fig. 10); they are easily recognised by their size ($\frac{1}{8}$ inch diameter) and colour, brown-speckled like a dark plover's egg. The nutlets are large enough to be impurities in seed corn of oats. Hemp nettle is not uncommon in potatoes, probably where the ridges have not been properly hoed between the plants. When abundant in oats, the large size of the plant would render hand-pulling (with gloves) possible and profitable. Reference has already been made to the great abundance of hemp nettle in recently ploughed land,¹ and this weed would have smothered a cabbage crop if it had not been hand-pulled. The probable origin was from oat straw brought with hay to feed sheep in winter.

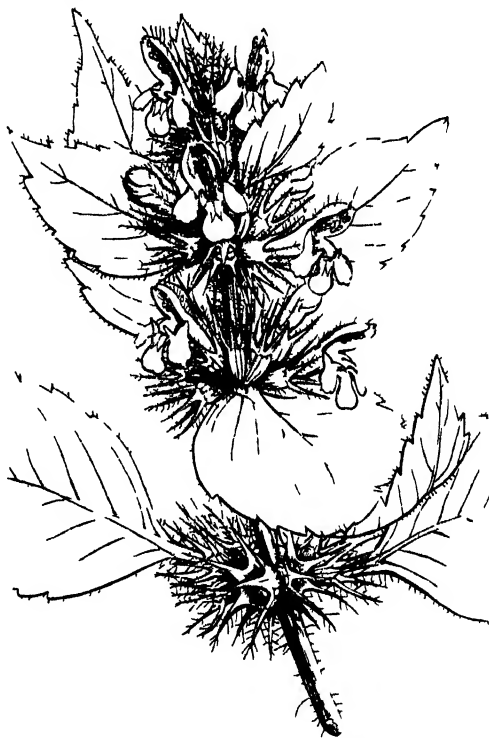


FIG. 10.—HEMP NETTLE. A FLOWERING BRANCH. (*Standard Cyclopedia of Agriculture*)

Poppy.—The well-known showy scarlet poppies include several species of the genus *Papaver*, all annuals and very similar in the finely divided foliage. The red poppy (*Papaver rhæas*) has fruit capsules $\frac{1}{2}$ inch in diameter, about as long as broad, and smooth. The long smooth-fruited poppy (*P. dubium*) has capsules narrower, twice as long as broad, and smooth; a rarer one (*P. argemone*) has the capsules similar but hairy. The capsules are unique, consisting of a cup-like part with a lid which does not fall off, but the minute seeds are dispersed through a number of small holes where the lid joins the cup. This arrangement prevents scattering of all the seeds at once, and as immature poppy capsules are harvested with the corn, they may become impurities in seed corn, and so carry some seed to new land. Poppies as corn-field weeds in Scotland are almost limited to the Lothians and southern Lowlands. Farther north they are not uncommon in waste places, and they may be introduced with wheat or other seed grain, but

¹ See *Journal* for Jan. 1921, p. 16.

only occasionally do they multiply to any extent. Poppies are favoured by frequent grain crops as these allow opportunity for seeding, but they are kept in check by root crops. The plant is not limited to any soil, but the lighter soils seem more favourable.



FIG 11 —FUMITORY
(Common Weeds, H. C. Long.)

Where poppy is an abundant weed it has been observed that spraying with copper or iron sulphate, as for charlock, reduces them considerably.

Fumitory (*Fumaria officinalis*) is a small plant, up to about 18 inches high, with small irregular pink or purplish flowers and finely cut foliage (Fig. 11). The one-seeded fruits, about $\frac{1}{8}$ inch diameter, are produced singly from each flower, and may occur as impurities

in red clover and grasses, more rarely in cereals. Among young crops the plant may become an abundant weed, but it is soon smothered by growing corn, and is easily uprooted by cleaning operations in root crops. It may become troublesome in young grass in stubble, but grazing with stock will soon reduce it.

Speedwells (*Veronica*).—The four or five annual species occurring as weeds are so similar that they may be described together. They are often conspicuous early in the year in winter wheat, and are known locally as "Mother of Wheat." They are low plants with trailing branches bearing numerous flowers that begin to open and to set seed within a few weeks after the seedling stage. The flowers are easily distinguished by the four petals, deep blue or white and blue, joined into a corolla about $\frac{1}{4}$ inch across, and easily shaken off. Another character is the two stamens. The capsules are heart-shaped, reversed with the point attached to the stalk, and two lobes more or less separated by a notch. Each half of the capsule contains a few whitish seeds like tiny fragments of bone. The seeds of the ivy-leaved speedwell (*Veronica hederæfolia*) are larger, about $\frac{1}{8}$ inch diameter, with a deep hollow in one side, and the whitish colour makes them conspicuous amongst stubble; many times the question has been asked whether they were "eggs" of some kind, but they can be distinguished by their hardness and shape. The speedwells occur on all soils, but the species varies from place to place. They are conspicuous weeds in young corn crops, but it has been observed (W. E. Brenchley) that later, among the taller corn, they disappear after scattering seed. Amongst young grass they may be rather common, but do not flourish in older grass. The blue speedwell of grassland is a perennial, germander speedwell (*Veronica chamædrys*).

The four weeds geranium, madder, pansy and forget-me-not are common impurities in grass and clover seeds, and are rarely abundant except in young grass and clover in stubble. The seeds in each case are about the size of clover seed, and are not easily cleaned out. The life history is fairly similar in each case. The seedlings make considerable growth during the autumn after the harvesting of the nurse crop, and the broad rosettes of leaves tend to suppress the grasses and clovers. Early in the following spring they produce long branches trailing amongst the grasses, and seeding begins early. The frequency of these weeds in young grass suggests that they are introduced with the clover seed, but the seedlings seen in other crops of the rotation probably come from seed ripened from plants on the land. As weeds they do not flourish amongst tall corn or in old grassland, and the cleaning of root-crops generally reduces them to a minor place.

Geraniums or Cranesbills.—The seeds of several species of annual geranium are included amongst the "noxious weeds" of the seed-testing stations. The seedlings seen in stubble have rosettes of rounded leaves, pink or red flowers $\frac{1}{4}$ to $\frac{1}{2}$ inch diameter, with five petals. Soft-leaved geranium (*G. molle*) has whitish, hairy, rounded, somewhat notched leaves, and reddish elongated smooth seeds. Small-flowered geranium (*G. pusillum*) has its leaves more notched, smaller flowers, and reddish brown small

smooth flattened seeds. The cut-leaved cranesbill (*G. dissectum*) has the leaves much dissected, long straggling branches, and dark oval seeds $\frac{1}{8}$ inch diameter, marked with fine pits.

Field Madder (*Sherardia arvensis*) belongs to the same order as cleavers (Fig. 6).¹ The leaves occur 4 to 6 together, about $\frac{1}{2}$ inch long, and sharp pointed. The whole plant is rather rough. The small lilac-blue flowers, $\frac{1}{8}$ inch diameter, are not conspicuous, as they are closely crowded in leafy clusters. The fruits, one or two to each flower, are common in clover seed, and are easily recognised by the irregular rounded shape, greyish speckled coat, and four or five sharp teeth at one end. This weed is not often abundant except in young grass.

Corn Pansy (*Viola tricolor*) has flowers like the cultivated pansy, but much smaller, rarely 1 inch in diameter, sometimes only $\frac{1}{2}$ inch, and varying in colour from yellow or blue to white. The seeds are shiny yellow or brownish, and egg-shaped, with a small notch at one end. The growth is straggling, and like the garden viola flowers are produced all summer and into autumn. It is a persistent weed in all cultivated land, but is rarely abundant enough to be serious.

Forget-me-nots (*Myosotis*).—The glossy black or brown seeds in clover seeds belong to more than one species of *Myosotis*, differing mainly in size. The rough hairy plants, not often a foot high, are branched and tufted. The flowers resemble the better-known blue forget-me-not of stream banks, but are smaller and duller in colour. Each flower produces four black or brown nutlets enclosed in a greenish cover, the calyx. The first stage in seed dispersal is that the rough hooked calyx sticks like a burr in fur or wool, and is carried away; balls of them tangled together may be found in threshing mill screenings. Later the glossy dark seeds or nutlets are liberated. Forget-me-nots are common weeds, but are only aggressive in new-sown grass.

Corn Cockle (*Lychnis* or *Agrostemma githago*) when growing in wheat is a tall erect plant with long narrow leaves, set on the stem in pairs. The large flowers, $1\frac{1}{2}$ to 2 inches diameter, have five reddish purple petals. The capsules are large, and contain a number of dark-coloured, somewhat triangular seeds, about $\frac{1}{8}$ inch diameter, with rough spiny coats. The seeds are not easily cleaned out of seed corn, and are said to be poisonous to poultry and pigs, though the evidence is somewhat conflicting (see H. C. Long, *Common Weeds*, p. 286). In Scotland this weed is seen only occasionally in wheat and barley, probably introduced as an impurity in the seed. Autumn-sown wheat favours it because the seed tends to germinate in autumn, and the seedlings grow during the winter.

Scarlet Pimpernel or Poor Man's Weather-glass (*Anagallis arvensis*) quickly catches the eye in sunny weather when its scarlet flowers open wide. It is a low annual with spreading branches, small oval leaves, flowers about $\frac{1}{2}$ inch diameter, and capsules like a small pea, with numerous minute rough brown seeds. The plant is not uncommon on cultivated land, but it is not a serious weed.

¹ See *Journal* for Jan. 1921, p. 26.

IV.—ANNUAL WEEDS WITH GREENISH FLOWERS.

This group includes weeds with small inconspicuous flowers, generally with no petals. Most of them have two kinds of flowers, some with stamens only, others which bear seed. The flowers are small and the parts not easy to distinguish, but the clusters of greenish flowers are generally conspicuous.

Goosefoot, Fathen, Meldweed.—The order *Chenopodiaceæ*, which includes useful plants like mangold, beet and spinach,⁵ has also its weed species. The common names given above suggest some features of the plants. The leaves are somewhat like the webbed foot of a water-bird—*e.g.* goose—more or less triangular,



FIG. 12.—SEEDLINGS OF WHITE GOOSEFOOT (*Chenopodium album*).
(*Common Weeds*, H. C. Long.)

with several midribs, and the margin lobed. The annual weed species have roughish leaves that look as if coated with a fine dust, and on rubbing they feel mealy, hence the name mealy or meldweed. The other name, fathen, suggests that the starchy seeds are good poultry food, and that the plant itself likes rich land. The names are used for several species not usually distinguished by the casual observer, and only to be identified on closer inspection. The two common species are tall-growing annuals.

White Goosefoot or Meldweed (*Chenopodium album*) is generally distinctly whitish and mealy even in the seedlings (Fig. 12), but specimens occur which are dull green and not specially mealy. The plant grows erect, the branches generally being directed upwards and not spreading as in the next species. The flowers are closely clustered, and each flower contains both stamens and pistil. The covering consists of five sepals which in the riper flowers are

seen clipping the fruit, like a jewel in its setting. The fruit is a one-seeded nut, and falls from the plant enclosed in the whitish calyx. It is in this white condition that many of the fruits are seen, in threshing mill screenings, but after hard screening, as for clovers and other seeds, the smaller nutlets found are about $\frac{1}{8}$ inch in diameter, black and glossy, round and flattened with a slight notch on one side. A large perennial species, Good King Henry (*Chenopodium bonus-henricus*), is sometimes seen about stackyards. It was once cultivated as a kind of spinach.



FIG. 13.—FATHEN OR ORACHE (*Atriplex patula*).
(Standard Cyclopedia of Agriculture.)

Fathen or Orache (*Atriplex patula*) resembles *Chenopodium* in a general way. The usual habit of growth is an erect main stem, from the base of which several strong branches grow out along the ground, hence a single plant may cover two or three square feet. The plants of *Atriplex* are generally tougher than those of goosefoot, and the foliage is dull dark green, not specially mealy. The lower leaves are usually more triangular (Fig. 13). The chief distinction is in the flower. *Atriplex* has separate flowers for stamens and seed, grouped together in clusters. The seed-bearing flowers consist of two triangular covers considerably larger than the black nutlet enclosed between them. The fruit enclosed in its covers is easily shaken off, and occurs on the field and in threshing mill screenings. When more thoroughly screened the black nutlets are shaken out and closely resemble those of goosefoot.

Chenopodium and *Atriplex* have a marked preference for farm-yard manure, and are generally to be found about the field "middens," or where manure has been dropped about field gates, hence a local name, muckweed or mixen weed. Several wild species flourish on the sea-shore where seaweed has washed ashore and rotted. Whether these become weeds in farmland is doubtful, but where seaweed is used as a field manure the weed goosefoot will grow strongly. The seeds are resistant to storage in farmyard manure, and can be seen in hundreds on clods of manure in the field, especially if it has not been well rotted. Experiments prove that the seeds survive digestion in pigs and fowls, and we have observed seedlings on cow droppings on grass and amongst heather.

The seeds are starchy, and liked by poultry, and have frequently been recorded in examinations of the crops of wild birds. They are long-lived in soil, as under grass, and as they are produced till late in autumn amongst root crops and stubble, there is generally an abundant supply of seed, perhaps more so on a well-manured farm than on a poor one. The root crops and the grass years offer the best opportunity for keeping these weeds in check, but in corn crops hand-pulling might be considered if they are specially abundant.

Small Stinging Nettle (*Urtica urens*).—This is a local weed in Scotland, almost confined to the light sandy soils, especially near the coast. There it is a persistent weed, perhaps more so in gardens and market gardens than in the fields, and as it is even more “stinging” than the perennial nettle, the hands must be protected while hand-weeding. The plant is a small annual with a simple tap-root, not many branches, and small leaves. The minute flowers are clustered, and the seed-bearing ones produce small greenish fruits.

Sun Spurge (*Euphorbia helioscopia*) is another weed more evident in the garden than in the field. Although several species are pests in England, the sun spurge is the commoner in Scotland. The plant is easily recognised by the abundant milky juice given off when it is broken; this is also seen in the dandelion, sow thistle, and other Compositæ whose flowers could not be confused with spurge (see Fig. 3). The plant often has only one stem about a foot high, sometimes two or three branches, and rounded oval leaves about 1 inch long. The flowers are borne at the top of the stem in a yellowish green cluster of about five branches bearing groups of flowers. The seeds, produced in capsules, are fairly large, about $\frac{1}{8}$ inch long, dark with a whitish bloom and a honeycomb-like surface.

Parsley Piert or Small Lady's Mantle (*Alchemilla arvensis*).—This is a low prostrate annual less than a foot high, with numerous branches bearing small and crowded leaves. The whole plant is characteristic and not likely to be confused except perhaps with small plants of speedwell, or a dwarf plant of parsley. The flowers are minute in greenish clusters crowded between leaves and stem.

Cudweeds are small plants with clustered branches and small leaves, all densely covered with short white down so that the whole plant has a woolly appearance. The name cudweed is used for species of *Gnaphalium* and for species of *Filago*, but they are not easy to distinguish. They frequent the poorer soils, generally in places with a thin crop or poor grass, and they may be abundant there, but from their small size they are not often serious weeds.

Annual Grasses.—Most grasses seen in arable land are plants of perennial grasses that do not flower till late in the season or in the following year. Annual meadow grass (*Poa annua*) is the common annual, distinguished by its simple fibrous root system, the broadish bright green leaves, and the early formation of green flower clusters arranged in an open branching ear. It is always one of the first grasses to appear on recently turned land, on paths and even between the paving blocks of a street. Seed is ripened all the year round, and seedlings spring up at all seasons, but the

plant rarely exceeds a foot high. It is kept in check by cleaning operations, though it soon reappears with great persistence.

Annual Brome Grass (*Bromus*).—Various species are common impurities in ryegrass seed. The grain is about the same length as that of ryegrass, but is distinctly broader, often flat with a wide opening on the "breast-side," or with the sides rolled in, thus leaving a narrower opening. The annual bromes are tall, more or less hairy, and with thin harsh leaves, so that they are not grazed by stock and are left to flower. The ear consists of clusters or spikelets of about ten grains, each cluster on a well-defined stalk, thus differing from ryegrass where the spikelets have no stalk. Bromes bear more seed per ear than the ryegrasses, hence a small number of grains in ryegrass seed will soon increase. The bromes are more evident in first year ryegrass hay than later, when grazing has begun, but in grass cut regularly for meadow hay they may become a pest, and they yield a light poor hay. Where present in quantity, bromes should be taken as a hint to plough up, or to improve by increased top-dressing to encourage the perennial grasses.

Wild Oats (*Avena fatua*, etc.) are not abundant weeds, except when introduced along with oat seed-grain. The plants have a lean and lanky appearance, compared with cultivated oats, and the ear is sparse. The grain is quite distinct, it is rarely white, but usually grey to dark-coloured, and has abundant hairs about the base of the chaffs. The better varieties of oats have no hairs or just a few short hairs about the base, hence grains with much hair are open to suspicion, especially if the hairs are dark. Each grain of wild oat bears a strong dark twisted awn, whereas cultivated oats have no awn, or if one is present it is only on the larger lower grain in each two or three grained cluster. Wild oats may be removed from seed corn by hand-picking, but new and clean seed is the better method.

(To be continued)

THE BEARING OF RECENT RESEARCH ON PROBLEMS OF NUTRITION.

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TOWARDS the end of the nineteenth century, analytical chemistry, which had been brought to a high standard of efficiency, provided the student with a more or less accurate knowledge of the composition of vegetable and animal tissues, the products of metabolism and the food nutrients essential for growth. Substances belonging to certain classes of chemical compounds had always been found in both vegetable and animal tissue, and were, therefore, assumed to be fundamental constituents of living tissue. These were proteins, carbohydrates, fats (including lipoids), mineral compounds and water.

Acting, therefore, upon the assumption that all the fundamental constituents had been isolated, the theory was advanced

by workers on problems relating to nutrition that these were the essential ingredients of a diet for the higher mammals. By means of many investigations, the student was able to follow fairly closely the fate of all the constituents in any food given to an animal and was further able to estimate the quantities of food ingredients retained by, and consequently thought necessary for, the animal's body under different circumstances. The "digestibility" of the essential food nutrients in all common foods, was determined in this manner, and from the results balanced rations were constructed to meet the requirements of all classes of stock under all conditions of life. These rations were all accurately balanced with regard to the proportion of digestible constituents and based on the minimum requirements of the animal.

The two main assumptions, then, upon which such standard rations were constructed were—(1) that proteins, carbohydrates, fats and mineral matter were the only essential food nutrients, and (2) that these substances, if equally digestible, had equal feeding values regardless of the source from which they were obtained.¹

Soon after the commencement of the present century, the resolution of the protein body into the constituent amino-acids by Fischer and the results of investigations, carried out by Osborne and other contemporaries, led to a better understanding of some of the problems of nutrition. It was shown that the amino-acids occurred in very different proportions in different proteins, and further, that they were *all* essential to a diet. In some plant proteins one or more amino-acids may be absent. It was, therefore, established that the food-value of a protein depended upon its yield of amino-acids, and consequently that proteins from different sources had not equal feeding values. Viewed from the stand-point of the supply of protein the amino-acid absent from, or deficient in, a ration practically determined the food-value of the ration.

The findings of Fischer and Osborne marked the beginning of very extensive experiments carried out with a view to testing the accuracy of many of the established principles of nutrition. These trials were carried out by appeal to the animal direct, and not, as in earlier trials, to the analytical chemist. Simplified rations, containing known ingredients all tested for purity, were adopted, and it was clearly proved that animals fed upon a diet containing only purified proteins, carbohydrates, fats and mineral matter, practically starved. The high point of interest was reached when it was found that the addition of butter-fat to the ration in place of other fats, such as lard or vegetable fats, appeared to correct the deficiencies, and animals to which the altered diet was fed were fully satisfied. Obviously then, butter-fat contained some substance or substances not found, or deficient, in other fats, which materially enhanced its feeding value. Such substances were termed "accessory factors" and later "vitamines." The bearing of these "vitamines" upon certain diseases added increased

¹ Modern experiments with calorimeters have shown that feeding stuffs cannot be evaluated on their analysis alone. For instance, the presence of much fibre in a food greatly lowers its feeding value, hence in constructing standard rations nowadays, attention is paid to the calculation of the ascertained starch equivalents of the foods used.

interest to their study : *e.g.* in the case of beriberi it has been proved that the substances deficient in the diet which caused the diseases were (1) a substance present in butter-fat and (2) an unidentified substance in the alcoholic extract of wheat grains. These have both been shown to be essential to the growth and health of an animal in addition to proteins, carbohydrates, fats and mineral matter. The substance found in butter-fat, and recently termed "fat soluble A," is also present in association with the fats of egg-yolk, of plant leaves, and of the glands of the body. The second substance which may be obtained by the alcoholic or water extractions of foods has been called "water soluble B."¹

Both are present, in varying amounts, in the actively growing cells of living tissue, and are therefore essential to nutrition. Fat soluble A is the more important as it is more liable to be deficient in common diets. In view of these discoveries, it may be instructive to sum up what is known of the value of foods, especially with regard to their vitamine content.

Milk is, undoubtedly, the most important of all foods for animals. It appears to be deficient only in iron, which may be more or less adequately supplied by ordinary water. Furthermore, it has been shown by Burge that there is a plentiful supply of iron in the body of the young suckling animal so that the deficiency in milk may be supplemented from this store.

It has been shown in experiments with pigs that milk supplies all the necessary food-nutrients required by the animal under all conditions, whether young or aged, pregnant or nursing. Experiments have also been carried out which prove the superiority of milk-proteins over those derived from other sources. In these experiments, the animal is fed at the commencement on a protein-free ration until such time as the nitrogen content of the urine becomes constant, representing the normal content of nitrogen derived from the destruction of body tissue. The animal is then fed on the food undergoing examination and the difference between the amounts of nitrogen taken in and excreted by the animal is accurately determined and represents the amount retained for growth. In trials with pigs, it was proved that 63 per cent. of the protein in milk is retained by the animal as compared with 26 per cent. in oats, 23 per cent. in wheat, and 20 per cent. in maize. Confirmatory results have been obtained in extensive trials with many different foods fed to the human subject. Again, it has been found that the amino-acids constituting the proteins of milk tend to supply the deficiencies of certain of these in other foods. Hence the especial value of milk where a variety of foods is being used. The ash of milk also is comparatively rich in calcium, sodium and chlorine, which are usually deficient in other foods. Finally, milk fat contains a large proportion of fat soluble A, and water soluble B is also present in milk in sufficient quantity. For these reasons, milk is a most valuable food for animals. There is no other food or mixture of foods which can be substituted for it, and there

¹ These substances have more recently been termed Vitamin A, and Vitamin B. A third vitamine water soluble C or Vitamin C has recently been isolated. Its absence in a diet causes scurvy and another name for it is the anti-scorbutic vitamine.

can be little doubt that the use of a larger quantity of milk in the feeding, even of adult animals, would result in better health, greater vitality and consequently longer life.

Turning now to seeds and their derivatives, it may be said that they have usually the following common characteristics:—(1) Their proteins are inferior in food-value to those of milk; (2) they are all deficient in calcium, sodium and chlorine; (3) (with the exception of millet seed) they are poor in their vitamines content. Vitamines are found in relatively larger quantities in the living cells of the embryo than in the endosperm. Consequently seeds with a large endosperm are poorer in these substances than those with only a small endosperm, and foods manufactured mainly from the endosperm have not such a high food-value as those derived from the germ.

It would appear, then, that in using seeds or their products as foods they must be supplemented in the quality of their proteins, in their content of mineral matter and in vitamines. Of course, by using a variety of seeds, there may be a tendency to correct the protein quality as it is unlikely that all seeds will be deficient in the same amino-acid. On the other hand, no manner of mixing will ensure a sufficiency of mineral matter or of fat soluble A to meet the animal's requirements.

In considering plant leaves, it has been found that their content of mineral matter is usually much greater than that of the seed of the same plant, which is accounted for by the fact that mineral matter accumulates in the leaf. There are also relatively larger amounts of calcium, sodium and chlorine present in the ash of the leaf than in that of the seed. Furthermore, leaf proteins tend to supplement seed proteins, although the percentage of protein in the leaf is usually less than that in the seed. The leaf is also considerably richer in fat soluble A than the seed. Consequently the use of leaves along with seeds or their derivatives will tend to supplement the latter in all three directions in which they are usually deficient, but it does not necessarily follow that such a mixture will always prove a highly satisfactory food. It is common to classify leaves, erroneously, as of poor feeding value because their content of proteins, carbohydrates and fat is relatively small and that of water is high, but rather they should be ranked very highly on account of the amounts of vitamines—*e.g.* fat soluble A and mineral matter contained in them. In this respect they are much more nearly "complete" foods than seeds or tubers. The larger and fleshier the leaf the nearer will it approximate in food-value to the seed.

Tubers and roots may be classified together for consideration. They generally have a high content of carbohydrates and water but are poor in proteins. They are also usually deficient in vitamines, although they contain a higher percentage of these than do seeds. In their feeding-value, they are more like seeds than leaves, but they differ very much in one respect—*viz.* that the organic nitrogen of seeds is generally present in the form of proteins, whereas in roots and tubers a considerable amount is present in a less complex form, often as amino-acids.

From the above observations it follows that fairly complete

rations can be constructed from seeds, leaves and roots or tubers. Generally speaking, however, a purely vegetable diet will not adequately nourish an animal during growth, nor will it maintain a mature animal in a state of perfect physiological activity for a long period. Such foods are usually deficient in vitamins and prolonged feeding with them impairs the vitality of the animal. The use of foods deficient in vitamins may cause abortion in the pregnant animal or, in any case, will materially weaken her powers of supplying nourishment to the foetus.

In the case of animals in milk, it has been shown that they may continue to supply more fat soluble A in their milk than they receive in their food, for which purpose they draw upon the store in their glandular organs,¹ and it seems reasonable to assume that when grazing during the summer the milk-cow makes good the amount of fat soluble A which she loses when housed in winter and fed on diets deficient in this substance. In all probability she prepares her store of vitamins in summer for the ensuing winter. Without such opportunities for renewing her store of fat soluble A, the chances are that her vitality would be sapped and she would more easily succumb to attacks of disease. Faulty dieting of animals is probably as great a factor in the spread of tuberculosis as unsatisfactory hygiene. Even amongst pigs, which one would have supposed to be little liable to tuberculosis, the percentage of fat pigs which suffer from this disease is very high even where strict attention is paid to selection and sanitary housing. Pigs, nowadays, are kept practically always indoors, and have not generally access to pasture. Further, they are usually fed (one might almost say forced) upon meals alone which are deficient in fat soluble A. When dairy by-products such as whey or butter-milk are used, the milk-fat has previously been almost entirely removed by very efficient dairy operations. The deficiency of fat soluble A is most certainly an aggravating influence to the ravages of tuberculosis, and there can be no doubt that the only successful and truly economical methods of pork-production are (1) to feed the pigs on meals with access to pasture, or (2) to use some quantity of milk or its by-products along with the meals. In the human subject, certain authorities assert that a deficiency of fat soluble A in the diet encourages tuberculosis as much as, if not more than, insanitary conditions. It is also of interest to note that milk forms a large part of the diet of patients in sanatoria where the disease is successfully treated.

From what has been said above about various classes of foods, it will be readily understood that the construction of rations upon a purely chemical basis is more than unsatisfactory. Until there is sufficient knowledge of the relative feeding values of different proteins to admit of the substitution of proteins from different sources for one another in a ration whilst leaving the feeding value of the ration unchanged, there can be only one basis for the construction of rations, and that is, the results of direct feeding trials. Fats, similarly, have been shown to have varying food-values, and furthermore, the limiting factor to the value of a ration may

¹ Vitamins are stored in the glands in the animal body—e.g. in the liver and pancreas.

be its content of mineral matter, which is not, at present, taken into account in the construction of rations. In addition to these, it is now known that the substances fat soluble A, water soluble B and water soluble C are as essential to the diet as proteins and consequently, until the value of feeding stuffs with regard to all these essential points can be accurately determined, standard rations cannot be drawn up in which the various food nutrients can be supplied from any desired source.

Were it possible to evaluate foods at the present time, it would be of the greatest benefit, because of the economical situation. There is at present only a limited supply of foods to supply a numerous animal population, and many of the systems of feeding are wasteful in that they are defective and inefficient. It is of importance, therefore, to consider rules which might act as guides in constructing rations for stock. For this purpose, certain principles must be kept in mind :

- (1) Mixtures of seeds or their derivatives, no matter how complex, can never fully satisfy the requirements of the animal.
- (2) The addition of tubers and roots to the above will not secure full nutrition and maintenance.
- (3) The addition of (a) plant leaves in proper proportions or (b) milk or its by-products to a mixture of seeds and tubers or roots will tend to correct deficiencies and promote proper nutrition.

Milk and plant leaves may be regarded as protective foods, of which the former is the more important. Either of them must be embodied in a diet to endure the well-being and permanent health of the animal. In connection with the construction of rations, it has been proved that if a diet be wanting in only one of the three factors in which a ration is liable to be deficient—viz. proteins, mineral matter and fat soluble A—animals can subsist on it for a much longer period than on one in which two of these factors are deficient. For example, a diet satisfactory in protein and mineral matter increases the animals' power of resisting the effects of a deficiency in vitamins.

It has been shown that vitamins, unlike enzymes, are not easily destroyed. Pasteurising, sterilising and condensing have no effect on the value of vitamins, and similarly the cooking, preserving or drying of foods does not injure them. Boiling with soda will, however, destroy them.

Having dealt generally with the construction of rations, it will be instructive to examine the results of a pig-feeding experiment recently carried out at the West of Scotland Agricultural College Experiment Station, Holmes Farm, Kilmarnock, with a view to discovering how far these results conform to, or may be explained by, the new principles of nutrition.

In this experiment 48 pigs were selected and fed on the same rations for 19 weeks. The amount of food given was regulated by the size, weight and progress of the pigs, and it was therefore altered from time to time. The pigs were weighed every week, on the same day and at the same hour. The appended table gives the average weekly gains in live weights of the 48 pigs :—

Week.			Average gain per Pig per week.	Week.			Average gain per Pig per week.
			lb.				lb.
1st	...	...	6.7	11th	...	...	14.1
2nd	...	...	7.0	12th	...	...	8.2
3rd	..	...	8.0	13th	...	...	7.3
4th	...	...	8.1	14th	...	...	10.6
5th	...	...	7.5	15th	...	...	14.8
6th	...	...	12.0	16th	...	...	8.4
7th	...	...	7.7	17th	...	...	11.7
8th	..	...	8.4	18th	...	...	9.1
9th	...	...	8.5	19th	...	...	8.1
10th	...	...	9.4				

The average weekly gain over the whole 19 weeks was 9.2 lb. per pig.

The ration consisted of a meal mixture containing equal parts of maize meal, bran and thirds, supplemented by whey. It was first altered at the beginning of the 4th week when each pig was allowed an extra $\frac{1}{2}$ gallon of whey per day. There was no significant change in the rate of fattening and at the beginning of the following week a further $\frac{1}{2}$ gallon of whey was given. The result of this was a slight decrease in the fattening rate. Obviously the addition of whey supplied no food-nutrient of which the pigs stood in need at the time, and in the 5th week the overfeeding caused derangement of the animal's system. Whey is poor in protein, and it was therefore inferred that the ration was deficient in protein, which the whey could not efficiently supply. At the beginning of the 6th week, therefore, each pig received an extra $\frac{1}{2}$ lb. of meals per day. There was, as a result of this, an increase in the rate of fattening equal to 60 per cent.

The protein in the meals evidently supplied a deficiency which whey was unable to supply. In the ensuing week, however, there was a big fall in the rate of fattening. This fall indicates that, in the previous week, the system had been receiving more than an adequate supply of food nutrients, with the exception of proteins. Whilst supplying the want of proteins, the additional meal overloaded the system with other constituents and caused a derangement of the normal physiological activities of the animal evidenced by the subsequent fall in the rate of fattening.

During the 8th and 9th weeks the ration was not altered, and the animals recovered in so far as the rate of fattening returned to nearer the normal. At the beginning of the 10th week, an extra $\frac{1}{2}$ lb. of meals was again added. This caused an increase in the rate of fattening, although not very marked, and it seems probable that the pigs were receiving approximately sufficient meals before the addition of $\frac{1}{2}$ lb. was made. In the following week, the whey ration was increased by a further $\frac{1}{2}$ gallon, with the result that the average rate of fattening rose from 9.4 lb. to 14.1 lb. per week. It is instructive to contrast the dietary deficiencies at this period with those in the early stages of the fattening process. During the 4th and 5th weeks, the addition of whey to the ration had an adverse

effect, whereas in the 11th week the extra whey caused a very considerable rise in the rate of fattening. Further, in the early stages, the addition of meal to the ration supplied the dietary deficiencies, and was the limiting factor to fattening, but later an additional meal allowance fails to produce any marked effect. At this later stage in the fattening process, some substance supplied by the whey favourably influences the rate of fattening, and is the limiting factor. From the composition of whey and a consideration of the ration, it seems reasonable to assume that the deficiency in the ration most marked at this stage is in fat soluble A. Certainly the deficiency might have been in mineral matter, but in trials where mineral matter has been known to be deficient there was nothing like such a marked change produced by supplying the want. Young pigs fed from birth on milk have present in their glands a fair amount of fat soluble A, and hence the addition of this substance in whey at the early stages of the experiment had little effect. Later, however, the store of this substance had become more or less exhausted, and the animals immediately responded to the extra whey in the 11th week. In the 12th week the animals returned to approximately their normal state, and the rate of fattening fell to 8.1 lb. per week. At the beginning of the 13th week it was decided to alter the ration in a double respect. Firstly, the mixture of meals was changed from equal parts of maize, bran and thirds to a mixture of two parts maize with one part each of bran and thirds. The reason for this was that it was thought that as the end of the fattening process was nearing, less proteins might be used. In addition to this alteration a further $\frac{1}{2}$ lb. of the meals was fed per day to the pigs. This double alteration caused a decline in the fattening rate from 8.2 lb. to 7.3 lb. per week, but in the following week the animals recovered and the rate of fattening rose to 10.5 lb. per week. This seems to indicate that the pigs were again receiving too little protein, which surmise was borne out in the 15th week, at the beginning of which it was decided to feed a further $\frac{1}{2}$ lb. of meal, and the rate of fattening rose to 14.8 lb. per pig per week. In the succeeding week, however, the rate of fattening dropped to 8.4 lb., which might indicate that in the previous week the animals were receiving more food nutrients, other than proteins, than they were capable of utilising (see explanation of decline of rate of fattening in the 7th week). During the 17th week a further change in the meal ration was adopted in that an equal quantity of barley meal was substituted for the maize meal with a view to improving the quality of the pork.

As far as is known, barley meal is slightly inferior to maize meal in the quality of its proteins, and in its fattening power. It was therefore puzzling to find that the change caused an increase in the rate of fattening from 8.4 lb. to 11.7 lb. per pig per week. As far as is known at present, this may be accounted for by the extra mineral matter, and especially calcium, which the barley meal contains. It is notable that the effect produced by this last change was of longer duration than at earlier stages in the process. In the 18th week the fattening rate was 9.1 lb. per pig, and it fell to 8.1 lb. in the last experimental week.

The results of the above experiment can be explained satis-

factorily only by the new principles of nutrition. There are many other problems in the study of nutrition which may now be more readily understood and accounted for and perhaps the following may serve as illustrations:—

- (1) Upon turning a stall-fed milk cow out to grass, or feeding her with green food, there is an immediate increase in her milk yield, which will sooner or later return to normal. The grass supplies the animal with fat soluble A and other vitamins, which are generally deficient in rations; and when this deficiency is supplied the milk returns to normal. Further the milk yield of cows grazing on pastures in autumn rapidly falls. Liberal feeding on green forage crops or turnips will prevent this fall to some extent by supplying the deficiency of vitamins in the pasture plants which have not such a high vitamin content in the autumn when they are not growing actively.
- (2) Brewers' grains (especially wet grains) liberally fed to milk cows produce a considerable increase in the yield of milk. During the process of malting there is an increase in the number of actively growing cells, and a consequent increase in the vitamin content. Brewers' grains have, therefore, a stimulating effect on milk yield.
- (3) The use with good results of cod liver oil, saccharified starch (starch fermented with yeast), and dripping as supplementary foods for calves, and of pressed yeast as a forcing food for dairy cows, may be explained by their containing relatively large quantities of fat soluble A.

Sufficient will have been said to emphasise the importance of the new principles of nutrition. There is every indication that the discovery of vitamins and an increased knowledge of their functions in nutrition will mark a new era in the history of the economic production of meat and milk. There is no claim to originality for many of the theories expounded in this article, and the writer has extensively consulted the works of McCollum, Funk, Hopkins, and others for material used in its compilation.

HIGHLAND PONIES.

I.—MAINLAND TYPE.

ROBERT INGLIS, Blair Atholl.

OF the varieties and breeds of horses, like the making of books, there is no end! But in few, if any, classes are the types so diversified as in that which brings together, under the style of "Highland Ponies," the equine products of the Northern glens and the Western Isles of Scotland. Of their earliest history there are no reliable records, but such meagre information as can be traced in no way militates against the theory of a common ancestry in an aboriginal breed in days now remote.

Such differences in characteristics as have been developed are probably attributable to two main causes:—(1) the amount and

quality of the sustenance available for the foals in the first year of their lives, and (2) the *pseudo* improvements arising from crossing. The former naturally resolves itself into a simple matter of substance and power; the latter, as a result of the mating having been directed principally to securing "greater pace," has tended to eliminate some of the chief points of a useful and hardy stamp of ponies.

The descent of the present Mainland or "heavy" type of pony is traceable from stocks which existed largely in Argyll, Perthshire and Inverness-shire, Lochaber in the last-named county being a veritable stronghold of the breed seventy or eighty years ago. But only in certain parts of Perthshire was out-crossing rigorously avoided, and so recently as a quarter of a century ago distinctive ponies of true Mainland type which did not betray some connection with those of Atholl were "few and far between." The proverbial "desperate measure," however, secured the essential remedy. The South African War was the means of prominently demonstrating the all-round usefulness and adaptability of the breed, and shortly thereafter strong efforts were made to check the existing indifference regarding it. By registration in the *National Pony Stud Book* a list of the stock of approved animals was made easily accessible to breeders, and by the promise of a material yearly subscription from that Society to the prize money in the Highland Pony classes of the Highland and Agricultural Society's Shows considerable impetus was given to the preservation of type and character. While it cannot be gainsaid that the position of the Highland pony in general has, both as to quality and numbers, reached a higher plane within the past decade, association with the National Pony Society has not been an altogether unmixed blessing. There has been on the part of some breeders too great a tendency—one had almost said anxiety—to promote the objects of that Society so far as relating to the breeding of riding ponies only. And on that rock has the galley of the breeders struck! The "Mainland" men will suffer no sacrifice of power such as might result from breeding with the hope of inducing the narrower sloping shoulders desired by the rider; animated solely by the preservation of the general utility of the breed, they seek strenuously to avoid the development of characteristics which would tend to serve an incidental or subsidiary purpose only.

The Mainland or heavier type of pony is not infrequently described as a "garron," which is simply a corruption of a Gaelic word meaning gelding, and the various points of the ideal pony of this type may be summarised as follows:—An attractive head, broad between bright prominent and kindly eyes which denote high courage when in a state of excitement; short between the eyes and muzzle, with wide nostrils admitting of full breathing power; ears short and well cocked up. The forelock between the eyes should be bushy but not too long, any scantiness of hair there detracting from the appearance. Viewed in profile the breadth rather than the length of the jawbone should be prominent. From the crest the neck should rise well with a flowing mane, the throat being clean and not fleshy. The capacious chest should be deep and open, and the shoulders moderately sloping, carrying their strength

well down and merging in a strong forearm with a broad knee. Sufficient packing behind the shoulder is never lacking. The withers should not be too pronounced and, however desirable a straight back may be, a slight depression is generally noticeable, but otherwise it is short and tight, and shows great strength at the loins. Thick across the heart, the ribs are deep, well sprung, and carried well back, avoiding all suspicion of a "wasp waist." For heavy breeching the quarters are strong and well rounded, the thighs abound with muscle, and the tail is strong and well set up. The hocks should be broad, fairly well bent and closely set, although, probably due to the heavy carrying required of him through successive generations, there is a tendency to a wideness of hock which is not easily eradicated. The legs should be flat in the bone, flinty to the touch, and without feather except the fetlocks. Oblique pasterns, not too short, and broad, firm hoofs, set well forward, conduce to easier movement, surety of foot and good carrying capacity on mossy ground. The action should be free, but not accentuated. The usual colours are cream and yellow and mouse duns, with the characteristic black list along the back, and greys, the last perhaps predominating. Height from 14 to 14'2.

Probably the most outstanding male of the breed known to the present generation was Herd Laddie (by Highland Laddie out of Jeannie), which was bred by the late Mr Donald M'Kenzie, Glengloy, Fort William, and won third prize at the Glasgow Highland Show of 1886. In 1887 Herd Laddie was bought as a six-year-old by the late Duke of Atholl, by whom he was again shown at the Edinburgh Highland Show of 1907, when the pony was awarded a special silver medal and, at the age of twenty-six years, won general commendation, being universally admired as the most typical Highland animal of the day. Professor Cossar Ewart, whose extensive experiments in conjunction with the Congested Districts Board were directed towards the breeding of stallions suitable for mating with the mares of crofters, described him as the only Highland pony he had ever seen which nearly approached perfection. Herd Laddie was retained as the Atholl stud pony serving in the district for twenty-two years, and the general improvement in the breed directly due to his impress is well nigh incalculable. A glance at vols. vii. and viii. of the *National Pony Society Stud Books* gives abundant evidence that his memory will be perpetuated in many different strains. Amongst females pride of place is given by the most competent judges to Lady Louise, a mouse dun mare with eel stripe, of great character and style, bred by Mr Colin Campbell, Glen Cluanie, Kyle of Lochalsh, from a horse belonging to the late Duke of Sutherland and bought for the Atholl stud in 1902. She was shown as an aged mare at Paisley Highland Show in 1913, when she won the championship of the breed, like honours having previously been secured by two of her progeny—viz. Lady Anne (by Herd Laddie) at Edinburgh Highland in 1907, and Lady Jean (by Bonnie Laddie, a son of Herd Laddie), at Dumfries Highland in 1910.

The real value of the Highland pony lies in his capacity to

perform successfully a great deal of hard work of a very varying nature, and to live inexpensively in those districts where the innate fatness of the land rivals not the fertility of Goshen. The authorities were not unduly tardy in their recognition of these merits, and from the grants annually voted by Parliament since 1807 for the welfare of the congested areas of the north and west of Scotland considerable sums have regularly been allocated for the development and improvement of the Highland breed of ponies. The stimulus thus afforded to the smaller breeders has resulted in a growing demand for stallions of a character which approximates to the Mainland type, and many useful animals of this stamp can be seen at Beechwood Farm, Inverness, where the Board of Agriculture for Scotland house their stud animals during the off season. A visit to this farm well repays a lover of the breed. There the assurance is repeatedly given that no pony is in greater demand, and none has a more regularly successful season than Atholl, a massive, upstanding, dark grey, with plenty of bone, moderately set shoulders and great strength across the loins, got by Herd Laddie out of Gaick Calliag, a fine type of the old Lochaber stock by Glengarry II., the Atholl stud horse which won second prize at Perth Highland in 1879.

Of the bearing of the Highland pony on the economic aspect of land settlement in the Highlands and Islands, it is impossible to speak too warmly. Many practical smallholders regard him as an indispensable complement to their success. No part of the farm work on any holding comes amiss to him, and his pluck, endurance and hardiness are remarkable. At the competition of the Western District of Atholl Ploughing Association in 1920 a competitor working a pair of grey pony mares was well forward in the prize list: abundant proof of their stamina. As to their staying power, no horses on the field were less perturbed by the day's darg than these typical mares, one of which, as a four-year-old, was the Edinburgh Highland champion of 1907, and neither of which had "turned a hair." They were easy winners of the prizes for the "best matched pair," and "quietest worked horses," their great natural sagacity enabling them to respond alertly to a soft and encouraging word. The smallholder who owns a good "garron" is the envied of his less fortunate brethren as he drives behind in state to "kirk, smithy, mill or market." Of his work "on the hill" it is equally easy to testify; indeed to the sportsman he is invaluable. Surefooted as a goat, he will traverse with unflagging pace and untiring energy long reaches of the roughest country, and from the recesses of the lonely deer forest he bears in triumph over moss-hag and crag those "antlered monarchs of the waste" which have fallen to the rifle. For the last class of work a smallholder with a well-trained pony has been readily paid for its hire from 50s. to 60s. weekly for the season of about eight weeks during the past few years. In the glens whence these ponies are mainly drawn such "season" hire rarely conflicts with essential harvest work, and it is thus seen that the sum accruing from the hiring forms no inconsiderable element in the financial reckoning. And yet the supply is seldom equal to the demand.

During the decade between 1903 and 1913 the annual encampments of the Lovat Scouts and Scottish Horse always served to bring forward fair numbers of Highland ponies to the training grounds. That the Highlander of either type was the most suitable animal for this class of work it would be futile to assert. On the road he cannot compete with the pace of animals which have a nearer relationship to racing or pacing breeds. But those who have taken part in, and seen the end of, a weary trek through the moors and morasses in which these yeomen frequently had to manœuvre will all agree that at such times the stout Mainlander came to his own. Given a reasonable time for the performance of his work no weight is a burden to him and no surface too soft or too rough to cross. For all pack purposes he is pre-eminent. Joint-ill or other vital complaints never curtail his longevity; barring accidents, he dies of the inanition which follows old age.

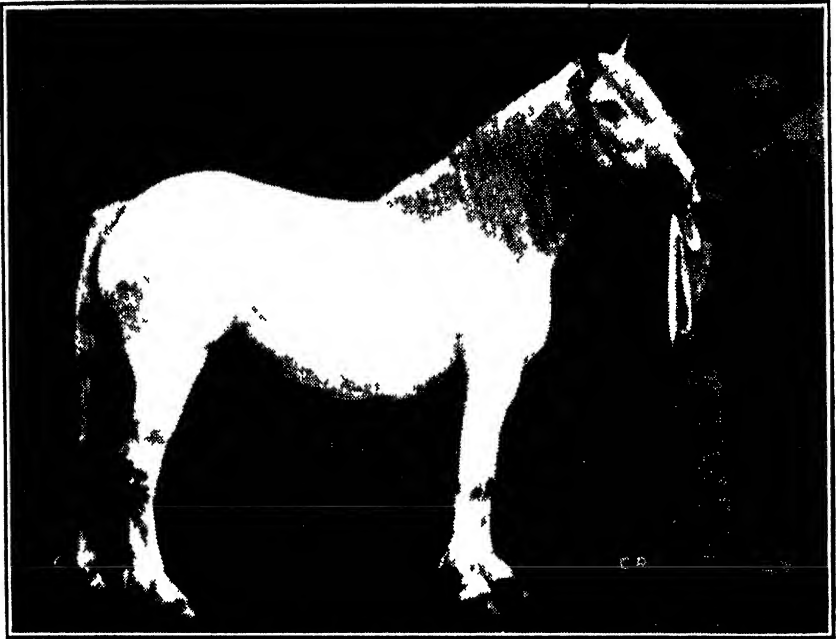
A healthy grumbling and discontent amongst breeders as to the frequently incongruous judging witnessed at the Highland Shows, cynical inquiries by spectators there as to what a Highland pony was, the lack of any central Scottish Association which would be representative and of practical assistance in the nomination of competent judges, alarm at the prospect of further spurious crossing and the absence of all co-operation in the marketing of surplus stock, whether of breeding quality or working capacity, led in combination to the formation, about ten years ago, at a large and enthusiastic meeting, held in Perth, of the Highland Pony Society. If the aims and objects of that Society have not quite conduced to unanimity amongst breeders generally, they have at any rate demonstrated the keener demand for, and considerably higher monetary value of, commercial animals of the Mainland type. Under the auspices of that Society annual sales have been held in Perth for some years, usually in the month of July, and strong geldings warranted in farm work and saddle have there realised as much as £92, while unbroken mares have sold readily at from £65 to £80.

For the first time on record the Mainland and Western Islands types of pony were judged by different judges at the Aberdeen Highland Show in 1920. More than one of the Mainland breeders entered stock in the Western Islands classes, but the compliment, if appreciated, was not returned. In a class of nine Western Island mares third prize was awarded to a Mainland breeder's pony tracing descent, directly on the female side, and indirectly on the male side, from Herd Laddie—that horse regarded by all Mainland men as the corner-stone of their equine edifice. The cleavage may be complete, but is the line of demarcation distinct? One wonders.

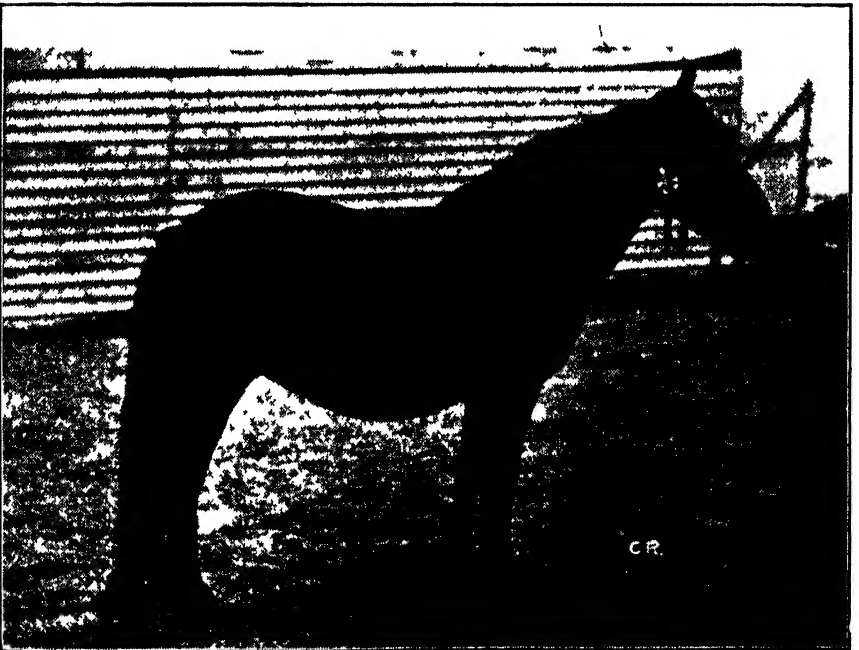
II.—WESTERN ISLAND TYPE.

J. MUNRO MACKENZIE, Calgary, Isle of Mull.

THE ponies of the Western Islands of Scotland may claim to be one of the oldest breeds in Great Britain. The original ponies were very small, most of them being under 12 hands, and many of



[Cat] Highland Pony Mare (Mamland), CATHACH BHAN III (2309). [Wishaw]
 Eight Years Old. Winner of Special Prize of the National Pony Stud Book, also President's Medal
 for Best Highland Pony at the Highland and Agricultural Society's Show, Edinburgh, 1919
 Bred and Exhibited by Mr JAMES M. CAHNS, Coulskill, Auchterarder



[Cat] Western Island Pony Mare, MORAR (3035) [Wishaw]
 Twelve Years Old. First and Winner of President's Medal at Highland and Agricultural
 Society's Show, Aberdeen, 1920. Bred by Miss North Mackenzie, Calgary, Isle of Mull
 Owned and Exhibited by Miss H. M. DUNCAN, Manran, Inverurie. Sire, Islesman (253)
 dam, Boudale (1296), by Highland Pony Stallion, Tallisker



ATHOLL, Highland Pony Stallion, Mainland Type.
Owned by THE BOARD OF AGRICULTURE FOR SCOTLAND. Bred at Blair Atholl.



Reid

HYSKEER, Western Island Pony Stallion.

Wishaw.

1st at Highland and Agricultural Society's Show at Aberdeen, 1908.
1st " " " " Inverness, 1911.
Owned by D. E. GRANT, West Australia. Bred at Calgary.

the purest ponies in the Outer Hebrides are under 13 hands high ; though the ponies of Mull and Uist run to a larger size.

In dealing with the ponies of the Western Islands, I am perhaps writing of them more as they were forty or fifty years ago than as they are now, as for some time there has been so much other blood introduced that very few of the original type are left, and it is to be hoped that the few that remain will be fostered and preserved in every possible way.

The Barra ponies were perhaps the purest breed to be found in the islands ; they stood from 12'2 to 13'2 hands. They were in most cases rather plain about the head, and some of them were cow-hocked, but they were hard, useful ponies, up to great weight, and first rate for carrying creels and working on crofts. Amongst them were to be found some very beautiful little ponies of perfect riding type, showing a lot of Arab blood. As to where that blood came from, there is considerable uncertainty, but it is known that some Arab stallions were brought into the islands from time to time, and there is also a theory that stallions from the Spanish Armada came on shore on some of the islands ; a strong case for this theory may be made out from the fact that good ponies were to be found all along the west coast wherever a Spanish ship was wrecked, from the south of England to the north of Scotland. The most common colours of the Barra ponies were bay, dun and grey, while there were also a few blacks ; the bays were more often found in Barra than in the other islands.

In the island of Rhum there were some very good ponies, of better quality and more distinctly of a riding type than the Barra ones ; most of them were black, from 13'2 to 14 hands high. The late Lord Salisbury, who owned Rhum, took a great interest in them, and his son, the late Lord Arthur Cecil, was devoted to them, and when, about 1882 or 1883, these ponies were sold off in Oban, Lord Arthur came up from the south and bought most of them. He used the stallions a great deal in the New Forest, and I see in a recent account of the New Forest ponies that these stallions did more good in the Forest than those of any other imported breed of ponies. Lord Arthur's son, Major Cecil, has still some of the breed, and I have also several mares by a pony I got from Lord Arthur, and am breeding from them in the hope of continuing this most valuable strain. Of late years these small Western Island ponies have been in great demand, and have fetched high prices, as much as £60 having been offered for one for the pits.

The ponies of Uist and Mull are bigger and stronger than the Barra and Rhum ponies, but for some years the tendency has been to introduce larger and coarser stallions, and this has almost done away with the very valuable pony of riding type that we used to see in these islands. The ponies I refer to were from 14 to 14'2 hands, had fine heads, necks and shoulders, with the best of legs and feet ; many of these ponies are first rate for riding and harness, and are up to great weight, and most of them have a very strong Arab look. These ponies are quite fit for light farm work, and are first-rate mounts for mounted infantry.

They did very well in the Scottish Horse, and carried heavy men and their kit without difficulty. Some of them have also

made quite good hunters in hill countries ; I remember seeing one, about forty years ago, carrying a heavy man well up to bounds in a stiff bank country in the north of England.

Some very good hunters have been bred from them by crossing with a thoroughbred or an Arab. Lord Middleton is mounting his hunt servants on horses bred in this way, and is delighted with the way they carry them. From a long experience I know that the pony produced by a cross of an Arab stallion and a Western Island pony mare makes one of the best long-distance hacks that it is possible to get, as I have done journeys on them of from sixty to seventy miles in a day ; and I am sure the time will come when the larger Western Island pony will be used for a foundation for breeding horses for military purposes. Authorities on horse-breeding seem to have come to the conclusion that pony blood must come into the future breeding of light horses, and no pony is more suitable than the larger Western Island pony of quality. For an all-round animal he cannot be beaten ; he is quite fit for light carting and all the farm work on a small farm, is a first-rate deer carrier, and is good for mounted infantry work, and for riding and driving. Like the smaller ponies, they have, for some years, been in great demand at high prices up to £70 and £80 for made ones, and from £35 to £45 for young unbroken colts and fillies rough off the hills ; but to make these prices they must have quality and be of a riding type.

The Western Island pony has the great advantage of being able to do a great deal of work on poor keep ; I have ridden them for days on end when they had very little more than they could pick up on the hillside, and for the greater part of the year they do best when kept outside.

Some years ago I had occasion to go over the roads in the island of Tiree, and when I landed I was much struck by the great quantity of oatmeal that was imported for the use of the people. Next day, when driving over the island, I said to the man who was driving me : " Tiree used to be called ' The Granary of the Islands ' ; how is it that you have now to import so much oatmeal ? " He replied : " In old times we had the hardy ponies that could work while living outside ; now the horses are so soft that they have to be stabled, and they eat nearly all the oats grown on the island, so there is none left to make oatmeal for the people." I believe the same is the case in a great many parts of the Highlands. I know myself that on many farms the work horses consume all the oats that are grown, and often even the seed corn has to be bought in. I quite admit that high prices have been got for the best of the cart horses bred in the islands, but a large residue of moderate and unsound ones has been left by the dealers, and I am sure the work could be done on the small farms by ponies. More corn could then be left for meal, and the fodder saved for the raising of more cattle, which is a most important matter in these times of scarcity of store stock.

With fair treatment these ponies live to a great age ; ponies of from twenty-five to thirty years are not uncommon, and I owned a mare that produced foals in her twenty-eighth, twenty-ninth and thirtieth years ; the three foals were all fine strong animals,

and were all winners of first prizes at the Highland and Agricultural Society's Shows.

Very few farms in the Hebrides are capable of breeding good large cart horses, and it is surely better to breed a first-rate pony than a second or third rate horse. Pony dealers have not been coming to the islands as they used to do, for the right type of pony has become so scarce, but if people would only breed them in sufficient numbers, I am quite sure that the dealers would again come for them. No other animal is so suitable for a smallholder, and if small holdings are to be successful they must be worked by an animal that can do well on a small amount of food, and that can face a considerable amount of hardship; none can do this better than the Western Island pony.

At the National Pony Society's Show, held in London in February, there was a class for mountain and moorland ponies of all British breeds. This produced a splendid display of native ponies. There were two groups of Highland ponies of the Western Island type shown, and though they did not win, they were greatly admired, and gained many friends. It is interesting to note that one of the groups came from a stud of Highland ponies lately formed in the very south of England.

FODDER VALUES.

DAN. W. STEUART, B.Sc.

I.—PIGS.

THE qualities which we look for in pigs, and upon which their economic value to the farmer largely depends, are—rapidity of growth, hardiness, fruitfulness, a suitable distribution of meat on the carcase, and an economical utilisation of their food. In order to judge their performance in this last respect we must have recourse to some simple method of fodder recording such as has already been described in the case of cows. Here again, in order to simplify matters, we have recourse to barley equivalents. To give the same result as 1 lb. of barley in fattening pigs 1.5 lbs. of broad bran are required, while 1.2 lbs. of bran would do in the case of cows. Accordingly we will define 1 lb. of barley equivalent as being 1 lb. of average barley, 1 lb. of the dry matter in roots, or that amount of any feeding stuff which will give the same amount of live-weight increase in fattening pigs as 1 lb. of barley, when fed in a suitable ration. It is equal to about .72 lbs. of Kellner's starch equivalent. (See Table, p. 156.)

If fodder records are properly arranged there will be a complete record of the food consumed in the year by the pigs. The method of recording the food of a sow is illustrated by the accompanying table (p. 157), which shows the food supplied during a whole year, including the extra food for the young pigs till they were weaned. We could easily calculate from these figures whether the young pigs paid for the sow's keep at current prices. Similar records would be kept for store pigs and fattening pigs; but in this case a group of pigs would be treated as a whole. Starting now

To 1 lb. of Barley Equivalent of the following Foodstuffs allow lb.	Average.	Variation.	Digestible Proteid therein.
			Lb.
Wheat	1'0	1-1'1	'093
Wheat Bran	1'5	1'4-1'6	'162
Fine Offals	1'0	1-1'1	'107
Barley	1'0	1-1'1	'065
Barley Bran	1'2	1'1-1'5	'070
Fine Offals	1'0	1-1'2	'092
Oats	1'2	1'2-1'4	'092
Oat Bran	1'8	1'6-2'0	'083
Oat Meal	1'2	1'2-1'5	'095
Rice Bran	1'1	1-1'2	'066
Maize	'95	'9-1	'062
Peas	1'0	'95-1'1	'172
Beans	1'0	'95-1'1	'193
Potatoes	3'6	3'5-5	'014
Potatoes (dried)	'9	'9-1	'016
Mangels	9'0	6'5-12	'036
Swedes	8'5	7-10	'042
Carrots	7'5	7-10	'037
Turnips	12'0	10-15	'048
Artichokes	4'5	...	'018
Molasses	1'3	1'1-1'5	'008
Malt Culms	1'5	...	'171
Acorns	1'8	...	'040
Acorns (dried)	1'1	...	'042
Beechmast (dried)	'8	...	'081
Meat Meal free from bone	'6	'6-7	'382
Meat Meal with bone (carcase meal)	1'0	'9-1'2	'269
Fish Meal	1'0	1'0-1'2	'470
Dried Blood	'65	'6-7	'494
Decorticated Nut Cake	1'0	...	'396
Soya Cake	1'0	...	'378
Sesame Cake	1'0	...	'324
Linseed Cake	1'0	...	'242
Palmnut Cake	1'0	...	'125
Coconut Cake	1'0	...	'163
Gluten Feed	'95	'9-1	'184
Young Clover	7'0	6-9	'147
Clover beginning to bloom	7'0	6-9	'119
Vetches (green)	10'0	8-12	'170
Skim Milk	6'0	5'5-6'5	'204
Butter Milk	6'0	5'5-7	'174
Whey	12'0	11-13	'108
Rape	10'0	...	'130

with pigs seven weeks old, the following figures show them fat for slaughter at 6 to 7 months old ; 24 pigs weighing 600 lbs. consumed grain (12,674 lbs.) and skim milk (30,637 lbs.) to the extent of 17,780 lbs. of barley equivalent and weighed finally 5025 lbs. (See Table, p. 158).

FODDER RECORD OF SOW. BORN 5/3/12.

Control day is the last day of each control period).

Dates.	Days.	Oats.	Barley.	Bran.	Skim Milk.	Whey.	Green Fodder.	Roots.	Total Barley Equivalent in period.	Barley Equivalent per day.	
1/11-15/11	15	Lbs. 16'5	Lbs. 16'5	Lbs. ...	Lbs. ...	Lbs. 99	Lbs. ...	Lbs. 165	Lbs. 59'0	Lbs. 4'0	{ Served 3/11/13 Farrowed 25/2/14 Served 27/4/14 Farrowed 19/8/14
16/11-30/11	15	16'5	16'5	...	...	99	...	165	59'0	4'0
1/12-15/12	15	16'5	16'5	...	...	99	...	198	63'1	4'2
16/12-31/12	16	17'6	17'6	...	...	106	...	205	67'1	4'2
1/1-15/1	15	19'8	19'8	99	...	198	69'3	4'6	Young pigs sold. 13/4 5 = 132 lbs. 16/4 6 = 149'6 lbs. 11 = 281'6 lbs. 11 = 275'0 lbs. 22 556'6 lbs.
16/1-30/1	15	19'8	19'8	...	...	99	...	198	69'3	4'6
31/1-14/2	15	24'8	24'8	...	...	99	...	198	78'3	5'3
15/2-1/3	15	24'8	24'8	...	...	99	...	198	78'3	5'3
2/3-16/3	15	33'0	33'0	49'5	198	198	150'9	10'5	
17/3-31/3	15	33'0	49'5	49'5	198	...	...	198	167'4	11'2
1/4-15/4	15	33'0	66'0	49'5	198	...	...	198	183'9	12'3
16/4-30/4	15	24'7	24'7	...	...	...	...	99	57'4	3'7
1st half-year	181	280'0	329'5	148'5	594	799	...	2224	1103'0	6'1	
2nd half-year	184	242'0	297'0	132'0	440	886	2420	880	1142'0	6'2	
Whole year	365	522'0	626'5	280'5	1034	1679	2420	3104	2245'0	6'15	

Date.	Av. Weight.	Increase per day per head.	Barley Equivalent.	
			per head per day.	per 1 lb. gain.
	Lbs.	Lbs.	Lbs.	Lbs.
6/8	25'1	...	...	...
19/9	62'7	8'4	2'6	3'06
16/10	102'5	1'54	5'5	3'62
16/11	148'1	1'47	6'2	4'20
20/12	195'6	1'41	6'6	4'68
16/1	(225'3)	1'54	7'5	4'89
Average		1'28	5'1	4'01

We note that the pigs produced on the average about 1½ lbs. of gain per day and 1 lb. from each 4 lbs. of barley equivalent. As the pigs grow older it requires more food to produce 1 lb. of gain. Pigs at weaning require about 3 lbs. barley value per 1 lb. gain, but a 280-lb. pig will require about 6 lbs. Similarly a calf requires about 3 units, but a fattening bullock some 8 to 11 units per 1 lb. increase. The object of keeping food records is to ascertain how the maximum live-weight increase may be obtained per lb. of barley equivalent fed, and at the lowest cost. In the last stage of fattening, bullocks may require more than twice as much food to produce 1 lb. of gain as they did at the commencement of the fattening period: but prime fat animals fetch a better price than second or third class beasts. Thus they will be sold when the feeding ceases to be remunerative.

Economical pig production depends largely on the extent to which we can make use of the coarser home-grown materials. In order to persuade the pigs to consume these to a greater extent it is quite usual to mix up food for one day and subject it to a sort of lactic fermentation for 24 hours. The chopped-up roots, green fodder, meals and dairy by-products are mixed at a temperature of about 68° F. with a little butter milk and the whole is allowed to ferment. In winter more sour milk is added and the temperature of the mixture when starting to ferment is higher—about 86°. Sour or fermented foods are not recommended for pigs under 2½ months or for breeding animals. Up to this age the pigs can digest whole grain (barley) fully as well as ground grain, but for older pigs the grain should be ground, and the harder grains must be ground fine. Till about 2½ months the skim milk fed should be supplied quite sweet and warmed to about 90° F. From this age till about 5 to 6 months old, from about 50 to 150 lbs. live-weight, is the growth or store period and this is the time to feed roots most heavily; it is also the best time to pasture or supply green fodder. During the fattening period, from 130 or 150 lbs. to 210 or 220 lbs., is the time when cooked potatoes have their greatest use. Cooking applies principally to swedes, potatoes and material containing weed seeds. There is no advantage in soaking well-ground grain for pigs, but with dry stuff like whole peas or dried grains steeping for twelve hours is an advantage. Green fodder may be chaffed and mixed with the other food. It should be used while still

young; not later than the beginning of the flowering stage, for pigs. Dry sows may have 50 to 70 per cent. of the food value of their ration as young green fodder; store pigs not more than 15 to 22 per cent.; and fattening pigs some 10 to 12 per cent., which should be reduced still further during the final few weeks. Roots may form 15 to 30 per cent. of the food value of the ration if uncooked and 30 to 35 per cent. if cooked. During the fattening period the quantity of roots must be reduced, but if cooked more can be fed than if simply raw and cut up. Potatoes can form only 20 per cent. of the food value of ration if raw, but if cooked may form 50 to 60 per cent. during the most suitable period. Sweet milk has a higher food value than sour milk. Food should be supplied at regular times and not more than the animals will clean up. Changes in feeding should be made gradually. Icy-cold fodder should never be fed.

It is sometimes important in feeding animals, and particularly pigs, to remember that a variety of foods in a ration often gives better returns than rations restricted to a single or a few foods. Thus it is seldom possible to get really good results from a mixture of seeds and their products when fed to young growing animals, pregnant animals or animals in milk. The proteids of the seeds have often a low biological value, their ash constituents are deficient in soda, lime and chlorine, and they contain too little of those mysterious, hitherto unidentified, growth-promoting substances known as vitamins A and C. Dairy by-products and green leaves contain the right things to supplement the grains and make a complete food. For this reason we should always try to include in the diet of young animals and mothers a certain proportion of dairy by-products, grass (good hay) leguminous herbage, or other leafy material. Fish meal, flesh meal and blood meal are also useful supplements for the seeds. Thus a good mixture of meals for young pigs can contain 5 to 10 per cent. of these and about 1 per cent. of precipitated chalk.

The feeding standards for pigs per animal and day are as follows:—

Live-weight.	Fattening Pigs:		Breeding Pigs.	
	Barley Equivalent.	Digestible Proteid.	Barley Equivalent.	Digestible Proteid.
Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
20	1'2	'15	1'2	'15
40	2'0	'23	2'0	'23
60	3'0	'30	2'8	'28
80	3'9	'38	3'3	'32
120	5'4	'45	4'4	'36
160	6'3	'47	5'1	'38
200	7'1	'51	5'7	'41
240	7'8	'55	6'3	'44
280	8'4	'57	7'0	'48
Sows in Milk 330 lbs.			9'9-13'2	1'1-1'32
Sows not in Milk 330 lbs.			3'3-5'1	'22-'35

A shortage of vitamine A tends to cause rickets in young animals. The vitamine C prevents scurvy. This latter substance is present in green stuff and roots, but is destroyed by cooking or drying. It is not, however, entirely destroyed in cooking potatoes. Pasteurising slightly but definitely reduces the value of skim milk for pigs; probably by decreasing the anti-scorbutic properties which it possesses.

According to Professor Hansson's experiments, fattening pigs between 110 and 220 lbs. live-weight should not get less than '065 to '07 lbs. of digestible proteid per 1 lb. of barley equivalent in the ration.

The following are a few rations in lbs. per head per day :—

330 lbs. Sow in middle of Lactation.

Barley	6'6	Barley	4'4
Wheat Bran	3'3	Oats	4'4
Skim Milk	13'2	Potatoes	6'6
Mangels	11'0	Blood Meal	'44
Barley equivalent	13'0	Barley equivalent	13'3

Each of these rations requires mixed in $\frac{1}{2}$ to $\frac{1}{2}$ oz. of precipitated chalk.

150 lbs. Fattening Pigs.

Barley or Maize	2'2	Barley or Maize	3'7
Roots—Mangels	14'3	Green Clover or Lucern	4'0
Skim Milk	13'2	Whey	20'0
Barley equivalent	6'2	Barley equivalent	6'2
Barley or Maize	4'0	Barley or Maize	1'8
Skim Milk	13'2	Cooked Potatoes	8'8
Barley equivalent	6'2	Whey	22'0
		Carcase Meal	'44
		Barley equivalent	6'2
Barley or Maize	2'2		
Cooked Potatoes	12'1	This last ration requires an addition	
Blood Meal	'44	of $\frac{1}{2}$ to $\frac{1}{2}$ oz. of diphosphate of	
Barley equivalent	6'2	lime.	

Pigs up to about 4 months old (100 lbs.) and breeding pigs must not be too closely confined: sunshine, fresh air and exercise are the cheapest tonics. They also require bone-forming minerals; so an addition of chalk or phosphate of lime to the ration is often necessary. The vitamins favour the retention of lime in the body and so assist the building of bones and teeth.

Some foods have a bad effect on the quality of the meat; rape seed, hemp cake, linseed or sesame cake, sunflower cake, rice bran, the brans of wheat and rye, and even maize itself. Some have a particularly favourable influence; such as skim milk, cocoanut and palmtree cake meals, barley, peas, potatoes, and even rye and oats. The others have usually quite a good effect; soya and groundnut cakes, green fodder, roots, middlings, whey, etc. These facts are considered in computing rations for pigs. Wheat or rye bran, for example, is restricted to the sows, while rice meal will be mixed with such meals as will counteract its adverse tendencies.

Cotton seed products should not be given to pigs. Molasses and molasses feeds must be supplied with the greatest care and in small quantities.

This article is based on Professor Hansson's *Var Svenska Svinskötsel*, published by C. E. Fritze, Stockholm.

II.—HORSES.

The methods of fodder control can profitably be extended to the stables, and with the help of the data thus obtained we are able to estimate the fodder costs of the stable as a whole, including the cost of breeding and rearing the young animals. Besides weighing up the food periodically the animals themselves should be weighed if the necessary apparatus is available. The cost of feeding the horses is no small item in the expenses of running a farm and this should be carefully scrutinised with a view to effecting economies.

A series of most interesting experiments has been conducted in Sweden on the feeding of work horses. In order to compare the values of the foodstuffs it was necessary to arrange two groups of horses as similar as possible in all respects. This was done by grouping all the left hand horses of each working pair to form one batch, the right horse of each pair being in the other group. The horses were weighed regularly, the rations of the two groups were alike except for the two foods being compared, and each experiment lasted at least one to two months. By arranging things thus each group would be doing practically the same work. The following unit values were thus obtained:—1 lb. of barley equals 1·2 lbs. of oats, ·95 to 1 lb. of maize, 1 lb. of molasses, 1·2 lbs. of bran, 1·8 lbs. of oat bran, 2·5 lbs. of mixed grass and clover hay, 1·1 lb. of the dry matter of roots or ·9 lb. of the dry matter of cooked potatoes. Molasses and molasses feeds have thus a higher food value for horses than for other animals.

In computing rations for horses the fodder unit values given in the previous paper, "Fodder Values for Dairy Herds" (October 1920), can be used, except in the case of molasses

An ordinary ration of timothy hay and oats contains about ·08 lb. of digestible proteid per unit and Professor Hansson's experiments indicate that the rations must not contain less than ·075-·08 lb. per unit for any considerable length of time. So when the ration consists largely of maize, roots, potatoes or molasses it must be completed with some food rich in proteid, such as earthen cake, gluten feed or good leguminous hay. These foods are also poor in certain mineral constituents, and for that reason, more especially in the case of growing horses and pregnant mares, they should be fed along with good hay; otherwise a little fodder phosphate (diphosphate of lime) is recommended, $\frac{3}{4}$ to 1 oz. per head per day mixed in the food; also the animals should have access to salt. If the ration contains a fair amount of bran a little precipitated chalk can be used instead of the phosphate.

Due to their characteristic dietic effects certain foods must be fed with care and the animals gradually accustomed to them. For example molasses must not exceed 5 lbs. per day and wheat

bran ought not to form more than $\frac{1}{3}$ of the grain ration. In this connection rye and barley straw are somewhat binding and oat straw laxative, while in a mixture they counteract one another.

To get the best results certain foods such as maize and oat bran must be ground fine. Oats can be fed whole in small quantities to young horses, but in larger quantities, or for older animals, like the other grains they should be roughly ground or bruised. Roots should be cut up immediately before feeding and are not cooked. In Scotland large quantities of cooked swedes have been fed successfully. Oil cakes should be crushed and mixed with the other concentrates.

Von Wendt found that in addition to the food required for maintenance, each hour of light work requires $\frac{1}{3}$ to $\frac{2}{3}$ units, medium work $\frac{2}{3}$ to $1\frac{1}{3}$ units and hard work $1\frac{1}{3}$ to 2 units; but of course the term hard work is relative, depending on the size of the horse. The food of horses must be graduated according to the amount and intensity of the work they are called upon to do. If not, then they will gain in weight during slack times and will lose weight when the hard work comes along. This is not economical. Variations from their average weights should be made as small as possible by proper control of the feeding, the food being increased however a few days before the harder work is expected to commence. The following data show the weights of four pairs of horses, each horse about 13 cwt., being maintained through a period of very hard work:—

<i>Dates.</i>	<i>Fodder Units per Head per Day.</i>	<i>Average Weight.</i>
21/2	—	1464 lbs.
21/2—20/3	20.9	loss 19 lbs.
21/3—16/4	24.2	gain 17 lbs.
17/4—15/5	32.1	loss 3 lbs.
16/5—12/6	25.3	gain 5 lbs.
13/6— 3/7	23.3	no change
3/7	—	1464 lbs.

The following feeding standards apply to about an 8 hours day:—

Per Head per Day.

Live Weight	10 cwt.		12 cwt.	
	Fodder Unit.	Digestible Proteid.	Fodder Unit.	Digestible Proteid.
		lb.		lb.
Maintenance ...	10	.75	11.3	.85
Light Work ...	14-16	1.0-1.2	16-18	1.1-1.3
Medium Work ...	16-20	1.2-1.6	18-22	1.3-1.8
Heavy Work ...	20-24	1.6-1.9	22-27	1.8-2.2
Very Heavy Work	24+	1.9+	27+	2.2+

With regard to the quantities of various foods which have been fed. Hay may go up to 38 lbs. and may be fed as the sole food to animals at light work. Straw should usually amount to

7 to 14 lbs., but up to 22 has been fed. It is usually chaffed and mixed with the concentrates. Green fodder 88 to 110 lbs. Roots have been fed in Sweden up to 44 lbs. raw. Those richest in sugar and dry matter suit horses best. Cooked potatoes can go up to 40 lbs. and raw to 14 lbs. Molasses to 5 lbs. Dried grains to 6 lbs. Fresh draff to 22 lbs. Barley may form $\frac{2}{3}$ of the concentrates—*i.e.* of the grain part of the ration. Oats up to 20 lbs. or so. Maize may form $\frac{1}{2}$ the concentrates. Beans, peas and vetches 2 to 3 lbs. Wheat or rye bran $\frac{1}{3}$ of the concentrates. A mixture of 60 per cent. oat bran and 40 per cent. rice meal is known in Sweden as Göta, and to horses this can be fed to 8 lbs. Linseed cake to 5 lbs. Palmnut cake up to $\frac{1}{3}$ of the concentrates is suggested. Earthnut cake to 2 lbs. Fresh, sound, mature acorns or horse-chestnuts can be crushed and up to 5 lbs. mixed with the other food: when dried they are ground. A mixture of 50 per cent. molasses, 35 to 40 per cent. of wheat bran and 10 to 15 per cent. of palm-kernel meal is a well-known molasses feed in Sweden, and it can be fed up to 7 to 8 lbs., or about half the concentrates: this mixture has about the same fodder value as oats.

The following are examples of Swedish rations fed during the course of experiments. They are for 12 cwt. horses doing hard work:—

Oats	24'2 lbs.	Oats	14'5 lbs.
Straw	8'8 "	Bran	2'2 "
Grass and Clover Hay	13'2 "	Maize	4'4 "
		Molasses	2'2 "
Fodder Units	27'5	Straw	15'4 "
		Fodder Units	24'3

Decort. Nut Cake	1'1 lbs.	Oats	11'0 lbs.
Oats	4'4 "	Barley	8'8 "
Barley	4'4 "	Peas	2'2 "
Bran	4'4 "	Straw	16'0 "
Hay	17'6 "	Fodder Units	24'0
Straw	17'8 "		
Fodder Units	24'3		

Mixed Hay	8'8 lbs.	Maize	11'0 lbs.
Oat Straw	8'8 "	Bran	5'5 "
Mangels	44'0 "	Cake	2'2 "
Oats	6'5 "	Molasses	2'2 "
Barley	6'5 lb.	Straw	13'2 "
Fodder Units	23'8	Cooked Potatoes	18'7 "
		Fodder Units	29'1

In arranging the ration of any class of animals one must consider its general suitability, whether it corresponds to the feeding standard in supplying the necessary amount of food value and digestible proteid, and also particularly the cost.

We have emphasised that as a general rule home-produced foods are cheaper than those purchased, and it is of importance to note that more food can be grown in an acre of good roots than in an acre of any other single crop. As roots are poor indigestible

proteid per unit, some good hay containing some leguminous plants, or some leguminous seeds (peas, beans, etc.) should be grown to feed with them. The following figures illustrate this point:—

Fodder Units per Acre.

Good Pasture	2200–2640
Hay, 2½ tons	2240
Oats, 7 qrs., 30 cwt. Straw	2740
Barley, 5 qrs., 20 cwt. Straw	2800
Potatoes, 6 tons	3360
Green Oats ½, Vetches ¾, 15 tons	3360
Turnips, 20 tons	3580
Swedes, 25 tons	6220
Mangels, 30 tons	6720
Sugar Beet, 12 tons	6720

This article is based on Professor Nils Hansson's publications, *Utfodringsforsök med Arbetshästar* and *Arbetshästernas Utfodring*.

BRAXY IN HARES.¹

J. P. M'GOWAN, M.A., M.D., B.Sc.

SINCE 1915 I have received from time to time from an area in the Central Highlands of Scotland several dead hares for examination. These animals were stated by the keepers and shepherds to have died from Braxy. The belief in such a possibility is not limited, however, to this quarter, for Braxy hares are spoken of as occurring in other parts of Scotland—*e.g.* in Dumfriesshire.

The chief facts in connection with the occurrence of the disease in the first-mentioned area are briefly as follows. The district over which the dead hares have been picked up is one of about a thousand acres, varying in altitude from four hundred to nearly a thousand feet. Thus the animals are not confined to any one type of feeding ground. There is the usual proportion of tillage lands throughout the area, but the hares have mostly been picked up on grass land, some of it old permanent pasture. In many cases, however, such old grasslands adjoined turnip-fields, to which the hares had free access.

The hares affected were the common brown hare.

As regards the extent to which the disease has existed it may be mentioned that in 1918 brown hares had become nearly extinct in this area, and fresh brown hares from another district were introduced at that time to try to prevent the stock dying out. Such an outcross ought in normal circumstances to have been beneficial, but the disease seemed to be as rampant as ever in the autumn of 1920. Although considerable numbers of hares were to be seen during the summer months, they became very much reduced in the autumn. As many as seven hares were found dead in one field at one time.

The keepers definitely differentiate between the deaths

¹ Received for publication 20th January 1921.

occurring in young hares and those in the older hares. They state that although there has been very little frost this season—only two or three slight touches—the deaths in young hares seem to have been particularly numerous, so that it would appear as if frost has not much to do with its onset. On the other hand, they assert that the deaths among the older hares are much more frequent after the turnips have got a touch of frost, and that such dead hares rapidly undergo decomposition. This year the deaths seem to have occurred chiefly among the young hares, and such young hares have been very lean. On the other hand, in former years the deaths generally took place among the older hares after a “rimy” morning, and the hares were always in good condition and underwent decomposition rapidly.

As will be seen from this short discussion, there is evidence that the term braxy has in all probability been used here to designate two distinct diseases. This point will be gone into more fully later. Meantime it seems to be unavoidable, in order to clear the ground, to discuss at some length the signification of the term braxy as applied in the case of other animals. This will be best carried out with reference to the disease braxy as it occurs in sheep, and the findings, if any, can then be carried over to the case of the hare disease.

The word Braxy, or Bradsoot, in essence means simply “the suddenly or quickly fatal illness.” In ordinary circumstances this should imply that the animal, the victim of this quickly fatal illness, should have been seen from the beginning of and during the attack up to the fatal issue. In certain cases this undoubtedly does happen, but in the majority the term is applied as the result of an inference that, as the animal now found dead was seen, a short time ago, apparently in perfect health, the disease that carried it off must have been a very rapidly fatal one. Obviously such reasoning implies a familiarity with the animal concerned which in the majority of cases could exist only where domesticated animals were involved. It will be seen, however, that even in this instance a certain looseness of designation has been introduced, in that domesticated animals need not die quickly necessarily always from the same disease. When the term comes to be applied to hares this looseness is much more obvious, as there is no evidence regarding the duration of the disease.

It behoves us therefore to take a wider survey of the whole natural history of the disease, envisaging thus the happenings during the life of the animal and the findings in its body after death to see whether, after all, especially in braxy of the sheep, there is not justification for the separation out of a large number of cases into one group to which the term braxy could be applied warrantably. Such cases having been separated out thus and labelled as one disease could have a definite appropriate treatment, etc., applied to them, as in the case for instance of typhoid fever in human beings. One can form some idea of what is meant here by noting the fact that in human medicine it was regarded as a great advance when Jenner first separated the well-known and distinct disease typhoid fever from the other well-known and distinct disease typhus fever, two diseases which up to that

time had been regarded as identical. It can hardly be doubted that the confusing of these two diseases previously was responsible in a large measure for the widespread nature of both, and for the failure to treat either successfully, as obviously measures directed against the one could not possibly prevail against the other—one, as is now known, being spread by faecal contamination, the other by the bite of insects.

In a previous paper¹ I described the natural history of the disease braxy in sheep; the countries where it occurs, and the situations in these countries; the time of year and the climatic conditions favouring it; the age of the animals and their condition of body and the occurrence of the disease in relation to the food. This description of the salient features of the disease was nothing more than a reasoned digest of the experiences of farmers, shepherds and others for the last hundred years, as well as of those of the present day. And it cannot be doubted from this description that there is a disease of sheep so rapidly fatal, and occurring so much more frequently than any other disease of a like nature, as to justify the attachment of the name braxy to it.

The question arises now whether one can define and recognise this disease by its effect on the animal itself, quite apart from the conditions alluded to above which give rise to it. From this point of view the symptoms of the disease may be discussed. Generally speaking, the symptoms are quite anomalous, and there is nothing distinctive about them to enable one to differentiate this disease from any other equally grave disease. As mentioned above, it is characterised by being always fatal, and rapidly so, and the significance of a disease of this nature, under the conditions mentioned above, has been pointed out already. All the circumstances considered therefore, it would appear to be a small assumption for a shepherd to make if, on finding a sheep dead under all the general conditions just referred to, and knowing that he had seen it in apparently perfect health a short time previously, he inferred that the animal had died from braxy. He is merely putting the important things before the negligible, and taking one chance in a hundred or less that he may be wrong. He does this, moreover, from a practical point of view, with the object of putting into action with regard to the other sheep any preventive measures he may put faith in, and the risk he takes in this connection would appear to be warranted.

Up to this point we have seen that there has been established by the ordinary methods of field natural history the existence of a disease among sheep which is entitled, from its prominent position among the suddenly fatal diseases of sheep, to the name of braxy. When, however, sheep which have died suddenly come to be examined after death, doubt seems to be cast on the validity of such a grouping. This is due to a set of circumstances so interwoven with one another that they are difficult at first to disentangle. Treating the matter historically, the first post-mortems on braxy sheep were performed by the shepherds themselves. They attempted to find a constant post-mortem appearance to correspond with the constant conditions under which they found braxy to

¹ M'Gowan, *Trans. High. and Agric. Soc.*, vol. xxvii., 1915, p. 54 *et seq.*

occur. It was only to be expected that considerable confusion would be introduced in this way by such a matter being in the hands of laymen. In my paper referred to above, this matter has been fully discussed, and there is no occasion to go into the matter again here. Suffice it to say that certain constant findings were obtained by some of them, and these have been more or less corroborated up to the present day. Thus James Hogg, the Ettrick shepherd, alluded to the "plum-coloured" spots in the fourth stomach but laid no particular stress on them. William Hogg, in 1829, recognised, however, their importance and stated that with a few cases excepted the fourth stomach was always the first and principal seat of the disease. Later Nielson, in 1888, laid so much stress on the plum-coloured spots in the fourth stomach that he called the disease on this account, by the name of gastro-mycosis ovis. Hamilton in his researches on the subject recognised this lesion as of importance, but regarded it as of the nature of a simple hæmorrhage and not of an inflammatory nature. He stated that it was present occasionally but by no means invariably. In my own work referred to above I have put forward the view that while I regard, as Hamilton does, the lesion in the fourth stomach as of a hæmorrhagic nature, such hæmorrhage is not always present in the fourth stomach in cases of the disease, and may occur equally characteristically in other parts of the body.

While, as has been suggested, the shepherds are at a disadvantage as regards knowledge of anatomy and pathological changes, they have a great advantage in that they are on the spot, can see the affected animals on occasion when they are alive, kill them and examine them when they are in an entirely fresh condition, thus avoiding the complicating and deceptive appearances brought about by putrefaction, which takes place very rapidly in the sheep. Much has been written, and a great deal of it with justification, concerning the importance of post-mortem action in masking the changes produced during life by the disease itself, and while, as mentioned above, shepherds cannot be expected to be experts in pathological anatomy, yet strangely enough William Hogg, in 1829, stated the case with regard to this matter in such a way that few points of importance have been added to it since. His remarks in this regard are of such fundamental importance, and sum up the pathological anatomy of the condition so well, even in the light of present-day knowledge, that although I have quoted them in my previous article (p. 66) no apology is necessary for repeating them here. Hogg, who was shepherd at Atterstane, Stobo, Peeblesshire, published his views in the *Transactions of the Highland and Agricultural Society* of 1829, vol. vii., p. 48. They are as follows: "The sickness is positively an inflammation of that department of the stomach denominated the reed. The rapid or tardy progress of the disorder, however, the position in which the animal has been lying previous to or at its death—the length of time between its dying and its being opened—all these in a carcase rapidly mortifying, with several other considerations which might be adduced, do really in different cases, and even in the same case, in a short time and in no small degree vary the

appearance of the affected organs. The writer of this essay has dissected several hundreds that have died of sickness, has opened them in all stages, and in the whole course of this his experience there has not been above one case in a hundred where it was not evident that the reed was and had been the first and principal part affected. But it is impossible to describe every appearance exhibited or the degrees of corruption that instantly takes place on different subjects within the same time. The temperature of the weather, the circumstance of the animal being smeared or white, the posture in which the animal dies and the state or situation it lies in from its death till its dissection, as was said above, all vary the appearances on dissection, and that in endless proportions. This diversity of appearances has led some to conjecture that the disorder begins in one part of the viscera and others that it begins in another. But, only a very few cases excepted, the reed is found always the first and principal seat of the disease. The reader will probably put the inquiry, How can it be known that the reed is the first of the intestines that is affected when the animal is not dissected till after its death? "Hogg replies to this objection by saying that he has seen the animals ailing, taken them home, killed them and examined them at once. He concludes by stating that "there is but one species of sickness or braxy, and to this day he has never seen any reason to alter his opinion."

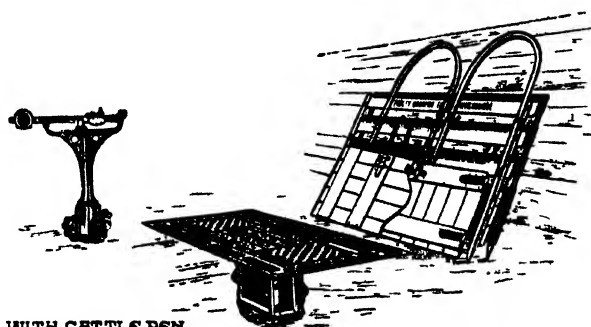
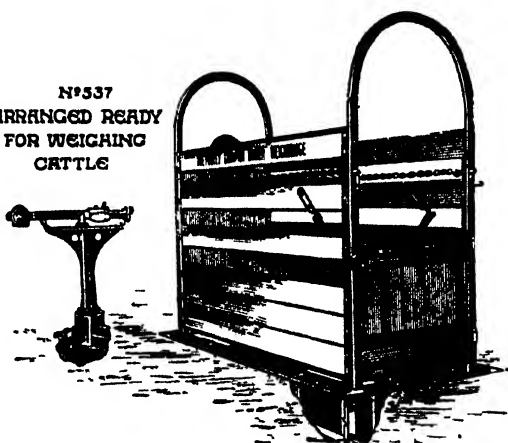
So far, then, the position has been arrived at that in sheep, from field observations on the natural history of the disease, for which shepherds are mainly responsible, and from post-mortem findings, in regard to which again a shepherd deserves great credit, the term braxy is justifiably applied to a single important disease. There falls now to be discussed the primary or bacteriological cause of the disease to determine whether this name can be justified on still another basis. Here necessarily the shepherd falls out of the running and the bacteriologist takes his place. The latter is hampered, however, by certain difficulties. As he does not live on the spot, he has usually to rely on somebody else procuring the material for him. This does not imply that the diagnosis by the shepherd, except possibly in a small percentage of cases, will be wrong, but that delay, with the inevitable concomitant progress of putrefaction, will take place. This putrefaction is harmful, apart altogether from the masking of the post-mortem appearances already referred to, in that the luxurious growth of the anaerobic putrefactive organisms may kill off entirely the much less robust organisms which may be actually causing the disease, if the delay alone, at a comparatively low temperature in contact with the blood juices, is not sufficient to do it of itself.

The organisms present in the dead body of an animal which has died of some disease or other may be of three kinds. First, the organism which caused the disease during the life of the animal and brought about its death; second, contaminating organisms from the surfaces of the body of a non-putrefactive nature, of which *Bacillus Coli* may serve as an example; and third, putrefactive organisms, which are practically without exception anaerobic. Now if putrefaction has advanced to a great extent

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organisms of Group 1., if they are of a non-resistant type, may not appear at all on cultures made from the animal's body, representatives of Groups 2 and 3 alone appearing. These latter are easily recognised in most instances for what they really are. If, however, an organism of Group 1 does appear, then there is a *prima facie* case for further investigation as to what its relation may be to the disease from which the animal died. This can be determined by separating out this organism in pure culture, growing it in artificial media outside the body for several generations and attempting to reproduce the disease by its injection in healthy animals of the species. This outlines the procedure that one would follow in an average case of braxy as one receives it. Fortunately, however, in my investigation of the disease I was not altogether dependent on material of this kind. I had the good fortune, as described in my paper, to obtain alive a hogg suffering from the disease, and to have it under observation for half-an-hour before its death. It died just as it was being lifted on to the post-mortem table. The post-mortem was done immediately, and from its heart blood a pure extensive culture of *Bacillus bipolaris septicus ovium* was obtained. This was grown in pure culture on artificial media for several generations, and was subsequently injected into several healthy sheep. All of them died from the injection within a period measured by hours. All showed the post-mortem appearances found in natural braxy, and one in particular, which died in fifteen hours, gave the plum-coloured spots in the fourth stomach regarded by some, as has been mentioned, as the one characteristic lesion in the disease. In all cases the organism originally injected was recovered in pure extensive culture from various sites in the dead bodies, thus completing what are termed Koch's postulates for the determination of an organism in question being the cause of a specific disease.

Having thus in such a case, where no contaminating organisms, putrefactive or otherwise, were in question, demonstrated the relation of the organism to the disease, it was an easy matter, by tests not involving the injection and sacrificing of sheep, to recognise the organism as such in braxy material as ordinarily obtained, and to accumulate cases which went to show that in other natural cases of the disease from various parts of the country, provided the material was obtained in fairly fresh condition, the organism was always present.

It would therefore appear, from what has been said up to this point, that the designation of the disease in sheep usually known as braxy by the term braxy is justifiable on a threefold basis—natural history, pathology and bacteriology—as being by far the most important suddenly fatal disease to which sheep are liable in this country. We have now to consider the disease braxy in hares in the light of this discussion.

In this case there is obviously much less opportunity for detailed observation of the natural history of the disease than is possible in the case of the sheep disease. The gamekeepers, however, definitely divided the disease into two sections—although they called them both braxy. In one case in which the young hares were affected they were emaciated by it before they

died, and in the other in which the older hares were the victims they generally were found dead in good condition after a touch of frost. No time could be stated in either case with regard to the duration of the illness, as in every case the animal was found dead without any previous history being available.

We come now to the appearances found on post-mortem examination in the two cases. Obviously there was every opportunity for putrefaction playing a prominent part, as the animals might have been dead for a considerable time before they were picked up. Nevertheless the two sets of animals could be easily divided into the two groups already mentioned on the basis of the pathological findings. Thus the young and small hares were very emaciated, exhibited no enlargement of the spleen and no pin-point abscesses in the liver; while on the other hand, they showed diarrhoea and marked lesions in various parts of the intestines. The older hares, on the other hand, were in good condition, and showed great enlargement of the spleen, and in some cases minute pin-point abscesses throughout the liver, but no change was observable in the intestines.

Discussing now the bacteriological findings in the two series, in no case was any growth whatever obtained by aerobic cultures from the heart blood or spleen of the smaller hares. On the other hand, examination microscopically of the fæces and of sections of the diseased intestine established the presence of advanced coccidiosis in all these cases. In the larger hares, however, aerobic cultures made from the spleen, liver and heart blood gave in every instance a pure extensive uncontaminated culture of an organism of the hæmorrhagic septicæmia group which resembles the organism of braxy in the sheep and which will be described more fully below. This organism in pure culture was grown outside the body for several generations, and on injection into rabbits reproduced in them the disease as it existed in the original hares—enlarged spleen and minute abscesses in the liver. It would seem, therefore, that in this instance Koch's postulates for the establishment of the organism as the cause of the disease have again been satisfied.

Special attention may here be directed to the following points brought out in this hare epidemic in view of their bearing on the question of the importance to be assigned to putrefactive changes. Thus, although the smaller hares must have been dead in some instances for days before they were examined, no growth, not even one of *Bacillus Coli*, was obtained by aerobic culture from their heart blood. Again in the case of the larger hares subject to the same conditions as the smaller ones, pure uncontaminated massive cultures of an organism of the hæmorrhagic septicæmia group were obtained from their heart blood, livers and spleens. In such a case one might reasonably have expected the growth of a few colonies of *Bacillus Coli*, but none was obtained. Such findings are eloquent testimony, if testimony were required in regard to what is and must be a routine practice in all pathology, whether human or animal, to the necessity of examining conscientiously every specimen, even a presumably putrefied carcass, if nothing better can be had. Putrefaction does complicate

matters, but only in the direction of obscuring the naked-eye post-mortem appearances, or at times of killing out or overgrowing and crowding out the less resistant pathogenic organisms.

A short description will now be given of the findings, etc., in the two series of hares mentioned above. In the first place, therefore, with regard to the hares suffering from coccidiosis, specimens of this condition were obtained only during last autumn, thus bearing out the contention of the keepers that the malady was affecting principally the young hares at the end of 1920, and that these young hares were very lean—both facts in marked contrast to what had happened in previous years. Several specimens of these young hares were obtained, and post-mortem examinations all showed practically the same appearances. They were emaciated, small hares, and extensive patches of coccidiosis were found distributed irregularly throughout the intestine, sometimes in the small intestines, sometimes in the caecum or colon, and sometimes in all three sites. The liver was not affected in any of the cases examined.

In connection with this epidemic of coccidiosis in the hares, it should be noted that "white liver," due to coccidiosis, has been observed to be marked among the young rabbits in the area concerned, but whether the diseases in the two animals are connected it is impossible to say.

With regard to the hæmorrhagic septicæmia condition in the hares, specimens have been received by me for examination at irregular intervals since 1915. In all these specimens the same post-mortem appearances were found and the same organism was obtained in pure extensive culture from the heart blood, spleen, and liver of all cases and in one case from the small intestine. The post-mortem appearances were briefly: very great enlargement of the spleen and in some cases minute pin-point abscesses in the liver. The characters of the organism obtained were as follows. It was a bacillus, appearing in the typical bi-polar staining form in the tissues, but endowed with great powers of pleomorphism when grown in artificial media. It assumed all forms from an undoubted coccal form through intermediate stages of a cocco bacillus, then a long bacillus to a long filamentous form. It was gram negative, non-motile and did not form spores. It grew on all the ordinary media, including those containing sodium taurocholate. It grew at room temperature on ordinary gelatine, but did not liquefy it. It produced acid without any gas formation in the following carbo-hydrate media—maltose, galactose, mannite, glucose, dextrin. In certain strains it produced acid in lactose, salicin and sorbite. In none of the strains was acid or gas produced in cane sugar or dulcitate media. Litmus milk was first made slightly acid and thereafter became alkaline. In the majority of the strains no indol was produced in peptone water, but in a few its presence was detected. Stalactite formation in butter broth as produced by the bacillus of bubonic plague was not tested for. The results of injection into animals was as follows. Injection into guinea-pigs, even intraperitoneally in fairly large amounts, produced no result. Injection intravenously into rabbits produced death within twenty-four hours, with all the

appearances of acute hæmorrhagic septicæmia—hæmorrhages and great effusion into the pericardial sac. Where the material was injected intraperitoneally into the rabbit, however, a sub-acute form of the disease, resembling in every respect that found in the original hares, was induced, in that the spleen was greatly enlarged, while minute pin-point abscesses in the liver were present. The effect of the organism on rats was not tested. The organism found here, therefore, is allied to, if not identical with, the organism that causes hæmorrhagic septicæmia in the rabbit, a well-known disease which has been the subject of much bacteriological study. It resembles also very closely the bacillus of human plague, an organism from which it has to be very carefully differentiated on many occasions in practice. How this is done is discussed fully in the Report of the Plague Commission in the *Journal of Hygiene*, vol. viii., 1908, p. 302, as also in a report by Martin and Rowland on rat plague in East Suffolk in 1910. In the latter case rabbit septicæmia and human plague occurred simultaneously in the wild rabbits in this area, and the differentiation of the two was a matter of some difficulty.

In conclusion we have seen that there is every justification for designating the disease of sheep generally known as braxy by the specific term braxy. The term thus applied means a definite well-defined disease. The question arises whether the term as defined for the sheep disease can be rightly applied to the disease in hares just described. Without hesitation one can at once say that it cannot be so used, for we have seen that the disease known as braxy in hares really consists of two diseases, coccidiosis and hæmorrhagic septicæmia. Of these two in no sense of the term can it be applied to the coccidiosis condition, but there is something to be said for its application to the hæmorrhagic septicæmia condition. Here the disease occurs in hares in good condition after a touch of frost, decomposition rapidly sets in and the causal organism is of the same group as that which causes braxy in the sheep. The only exceptionable consideration to the complete logical use of the term is that in hares the disease, though fairly acute, seems to be, from the post-mortem findings, not so rapidly fatal as braxy in the sheep.

WHITE SCOUR OF CHICKENS.

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WHITE scour is the most formidable disease to which chickens are liable. It affects the birds in the first few days of life, some dying the day after they are hatched. Affected chickens seem dull and sleepy, stand about with ruffled feathers and drooping wings, refuse to eat, and keep passing frothy soft whitish-yellow droppings which seem to hurt, for the chick generally cries out at the time. Some of them have the feathers about the vent quite pasted up. As they become weaker, they sway backwards and forwards when they try to stand, and soon drop down and die.

Some live several days, but are dull, off their feed, and sometimes have swollen feet and become very lame—resting a lot on one leg—and when viewed from behind they seem hunched up and swollen-looking and are scoured like the others.

There is not much to be seen on examination of the dead chickens, but that little is characteristic; the bowels contain some frothy whitish-yellow material, and are reddened in places; the yolk is not properly absorbed; the liver is yellowish in colour and traversed by reddish streaks; and the lungs occasionally show tiny yellowish-white spots the size of a small pin's head scattered throughout their substance. An examination of the blood proves the disease to be white scour, or, as it is frequently called, bacillary white diarrhœa; such laboratory examination is necessary because the symptoms of this disease are very similar to those of two other serious chicken pests—namely, coccidiosis and pneumo-mycosis—the first of which, however, usually attacks somewhat older chickens, and the second is happily comparatively rare. Moreover, as bacillary white diarrhœa is an acute septicæmia, the dead bird may show no gross signs of disease when opened, and a microscopical examination is necessary to establish the diagnosis.

Chickens which survive an attack may still have the germs of the disease in their bodies, and there the germs live and multiply to a small extent, frequently becoming located in the ovary of the pullet so that when later on the egg is formed the germs are included. When the egg is laid the germs are still present in it, and from the egg they gain entrance to the growing embryo which they may kill before development is complete; but if the egg does hatch the chicken is infected and may develop the complaint and soon die after passing the germs on to some of its fellows who had the good fortune to be hatched without them.

Thus while bad management and unclean surroundings predispose chickens to this disease, it may break out among birds whose surroundings and treatment are unexceptionable. Chickens so infected through food or water soiled with the droppings of an infected chicken may show signs of the disease from four to ten days afterwards. Such chickens are most liable to take the disease during the first two days of life; after the third day they are more resistant, and if they reach four days of age without becoming infected they have a good chance of escaping, because with their increased strength they are better able to withstand infection or to destroy the germ if it gains entrance to their bodies. Incubators, brooders, boxes, utensils, etc., which have been used by diseased chickens will spread the infection to healthy chickens coming in contact with them before they are thoroughly disinfected; so will the poultry-keeper who has been handling diseased chickens unless he very thoroughly disinfects his hands and boots and changes his overall. The disease is carried to other areas when infected day-old chickens are sent away, and when infected eggs are sold for hatching purposes. Such bought-in chickens or eggs should be kept away from a healthy stock until the risk of the disease appearing has passed—from two to four weeks. Day-old chickens which have the germs in them may contract a chill if sent away too early, and may then develop white

scour on arrival at their destination, the debility induced favouring the development of the disease which otherwise they might have escaped.

Chickens which survive an attack often remain backward in growth and unthrifty in appearance. Moreover, as already pointed out, they may become, as pullets and hens, carriers of the disease, and the most important and prolific source of infection ; so that the first principle to be observed in attempts to control this disease is the weeding out of such carriers from among the breeding stock ; and this consideration raises the question : How may we detect hens which harbour the infection, but show no sign of the disease ? In the first place certain laboratory tests have been devised, and the application of these will enable us to detect infected hens in a notable proportion of cases, but these tests require expert application, and professional help must be sought if they are to be employed.

Healthy hens may occasionally become infected by feeding upon foodstuffs soiled with the droppings of diseased chickens, or by feeding upon eggs which contain the germs. Hens which harbour the infection often show, when examined after death, changes in the ovary, for the recognition of which, however, a trained eye is required ; thus to confirm the existence of the disease a bacteriological examination is necessary.

The second preventive measure against white scour is to use for hatching purposes only eggs which are known to have come from flocks free from the infection. Before setting, the eggs may be wiped with 95 per cent. alcohol in water (Morse).

The third precaution to be taken is to kill and destroy by burning or by burial in lime all diseased chickens, as individual treatment is not desirable. The droppings should also be burned or buried in lime.

Fourthly, if an outbreak of the disease be anticipated potassium permanganate may be placed in the drinking water in the proportion of two and a half grains to the gallon, or sufficient to give the water a mauve colour. By its antiseptic action it reduces the risk of healthy chickens becoming infected by drinking water soiled by their diseased companions. Good sour milk or buttermilk may be placed before the chickens, which, however, do not require feeding for two or even three days after hatching. Lactic cheese has been used with some success in these laboratories.

Fifthly, if it be desired to raise chickens from an infected flock, the method suggested by Ward and Gallagher¹ may be used. This method involves the use of incubator trays of the pedigree type with solid compartments sufficiently high to prevent the chickens in adjacent compartments from coming in contact with one another. These trays are to be used for a few days before the hatching takes place, and for three days afterwards, when the chickens may all be allowed to run together if no sign of disease has appeared. The trays may be placed in the brooders, or these may be provided with a similar device, and care must be taken not to mix the separate lots of chickens when transferring them. If the chickens in any compartment show signs of disease they should

¹ Ward and Gallagher, *loc. cit.*, p. 74.

be destroyed and the compartment should be disinfected. The attendant should disinfect his hands, etc., before attending to other chickens.

An examination of the egg is not of value as a means of detecting hens affected by this disease, as not every egg laid by an infected hen contains the germ of white scour.

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LAND SETTLEMENT IN SCOTLAND

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(*Paper read before the Glasgow Agricultural Discussion Society.*)

LAND Settlement in Scotland is best dealt with by treating separately the crofting counties (with which should be reckoned the island of Arran and parts of Perthshire) and the rest of Scotland.

In the crofting counties the question is fairly simple and uniform. There is a definite demand for land to be satisfied and a definite purpose to be served. The agrarian question in these counties has been prominently before the public for at least a generation, and in 1885 the crofters and cottars obtained the franchise, and accordingly since then their demands have had to be treated seriously.

The Crofters Holdings Act, 1886, did not follow the recommendations of the Napier Commission, which had been appointed a year or two before to inquire into the grievances of the crofters. That Commission found that what was mainly wrong was that the crofters and cottars were in want of more land, because the land on which their holdings were placed was not sufficient to keep them, and accordingly the formation of new townships was recommended. Parliament, however, ignored this recommendation and dealt with the need for more land only by authorising the Crofters Commission to grant enlargements (which would be mainly additions to the common grazings) of existing crofter holdings. Even this statutory provision was so restricted and defective that it was of little use; otherwise the Crofters Holdings Act safeguarded the position of crofters in respect of their existing

holdings by giving them fixity of tenure, judicial rents and compensation for improvements. There was little chance of crofters and cottars getting more land except by State action, for landowners were not likely of their own accord to make land available, and the crofters themselves were not in a position to offer for land in competition with sheep farmers. It is true that about this time sheep farms began to fall vacant and they were often cleared to be let as deer forests. It was a rare thing for a landowner to offer vacant sheep farms to groups of crofters instead of clearing them; but of course the process of clearing went on chiefly on the mainland, and only the deer forests formed on the western seaboard of Inverness, Ross and Sutherland were situated very near crofting townships.

The Congested Districts (Scotland) Act, 1897, and the Small-Landholders Act, 1911, contained provisions for the creation of new holdings and enlargements for the crofter and cottar population.

The conditions of life differ to a certain extent in the different parts of the crofting counties. It must be remembered that the total area is large, stretching from Shetland in the north to Kintyre in the south. Physically the country is not all highland. It is so in the greater part of Argyll, Inverness, Ross and Sutherland, but Caithness and Orkney are lowland areas. The Outer Hebrides, except Harris, are not highland territory. The west side of South Uist is partly below sea-level. The northern groups of islands are neither highland nor Celtic. Shetland comes nearer socially to the Hebrides than to Orkney—the Shetlander being, like many of the Lewismen, a fisherman with a croft, while the Orkneyman is a small farmer.

One important distinction affecting the whole area may be drawn between the western districts, mainland and insular, where the crofter township with common grazings is the economic unit, and the Moray Firth district, where the crofters hold their crofts in severalty, such crofts being more like the small arable holdings common in Aberdeen and Banff.

It may be mentioned that Caithness and Argyll are the two crofting counties in which the old process of replacing crofts by farms had gone furthest. Hence in Caithness particularly there has long been a considerable demand for land.

The process of satisfying this demand is not then one which has only begun since the war. It has been going on for a generation. The war has indeed given the West Highland and Hebridean people a new "formula" to be used in support of their claims. Nor is such a movement confined to Scotland. Over most of Europe, wherever a peasant community finds itself near land owned by landowners and occupied by them or by large tenants, unless there are town industries at hand to draw off the young men, or emigration has become fashionable, the pressure exerted by the peasantry in the direction of settling their surplus upon the other land is usually found irresistible. Such has been the case in Russia during the past few years, where the forcible seizure of large estates by the peasantry was part of the process of revolution. A similar movement has lately manifested itself in Sicily.

In Rumania, a country wherein the nobility have oppressed the peasantry for generations, the latter have now come into their own, and a law has lately been passed making 800 acres the limit of any estate; and that in a country where it was not uncommon for landowners to own thousands of acres. The surplus of all estates in excess of 800 acres has to be made available to be sold to form peasant holdings.

Anything done in the crofting counties of Scotland is mild compared with this. Indeed the process of reinstating the crofter is now generally acquiesced in, and criticism is usually confined to the details of schemes by which the purpose is realised. One sound principle, it may be conceded, does underlie many of these criticisms—the principle that fresh land should not be allotted to crofters and cottars under such conditions that no permanent improvement is thereby guaranteed in their social condition. Put more positively, what is desirable is that public departments charged with land settlement should try to provide crofters with economic holdings, to use an expression which became current during the working out of a similar problem in the West of Ireland. From this point of view, the framers of the Crofters Holdings Act, 1886, were well advised in making provision at least for the enlargement of crofters' holdings, which in practice usually means the enlargement of their common grazings, as land for arable enlargements is often scarce. Great good has, therefore, been done by the granting of such enlargements in the districts in which crofting townships with common grazings are common. The land for these enlargements has usually been taken from sheep farms, and occasionally from deer forests, the latter being usually too expensive to take under the Act of 1911. Enlargements, however, do not always meet the case. Where most of the holdings in a township are very small (this result being often reached by sub-letting to cottars, as has happened mainly in the Hebrides) it is necessary to thin out the township and plant the migrants in a new township. In Northern Argyll, Western Inverness, West Ross and the greater part of Sutherland and Skye the crofter is something of a sheep farmer, and the simple and obvious way of "relieving congestion," as it is called in such districts, is to take a sheep farm and subdivide it into a certain number of crofts. This can be done without incurring the risks that the pure agriculturist is wont to condemn, and in any case sheep farming itself in the Highlands has not been a decided economic success in the past generation—as witness the great number of such subjects cleared of their stock and turned into deer forests.

No "agriculturist" would prefer to see a sheep farm become a deer forest rather than a crofter settlement. In the latter case there is no great change in the management of the land. The sheep stock remain there as a club stock, looked after by a shepherd. It is merely the substitution of a copartnership for an individual. It is true that usually the crofters have not the money to take over the club stock and pay for it at entry, and a great part of the purchase price has to be advanced. A grudging critic might carp at this arrangement, but in the long run it is better that public money should be laid out in maintaining the land at a level of

production at least as high as that reached when it was a single farm than that the crofters should be left to stock it as they like. The result would only be to have a number of small flocks of 50 or 100 sheep of poor quality, with resultant quarrelling among the crofters herding the stock and an undesirable number of mischievous dogs ranging the hill-sides.

If this were allowed overstocking would in time ensue, the soumings would be exceeded and surreptitious subletting would go on. The letting value of the grazing would go down. On the other hand, the club stock involves the minimum of disturbance in the existing system, it tends to raise the level of prosperity of each crofter family, and its arrangements are such as to make it difficult for them to fall back to a lower level—and in time of course they have become so accustomed to the new state of things that they tend to suppress any inclination towards a deviation from the settled policy, such as might undo all the work of improvement. In certain directions the crofter settlement shows a positive gain on the single sheep farm, the great drawback of which is that it is starved of labour for any other purpose than the actual herding. The crofters always cultivate the low ground with oats and potatoes; they cut more hay, and they keep more cattle than were kept on the sheep farm. Indeed a slight drop in the sheep stock and an increase in the cattle stock are the usual marks of the conversion of a sheep farm into a crofter settlement.

In the eastern parts of Inverness, Ross, the little stretch of Sutherland on the Moray Firth, Caithness and Orkney, the crofter is generally a small holder, who raises polled Angus or other stores, grows some oats and roots, and may buy in sheep at the back end to sell in the spring. The enclosed area of his holding may reach thirty acres or more.

The parish of Latheron in Caithness is, however, more like the west coast in having a great number of small crofts, and along the coast of Caithness there are a number of rather decaying fishing villages.

The East Coast crofter is past the stage at which he might wish to subdivide his croft in order to provide for a son or a son-in-law. But he makes his crofting enough of a success to cause the next generation to want to go on with the life. There is thus in these districts a demand for more land for crofts, which can be provided only by breaking up arable farms, and this is a more serious matter than subdividing hill sheep farms. It has, however, been done to a considerable extent in Caithness, and slightly in Orkney, but very little in Ross and Inverness.

It can safely be claimed that in no county has a greater number of more satisfactory land settlement schemes been carried through than in Caithness. The holdings are usually of a fair size, about 60 acres, and men of a good type, coming from the crofters and farm workers, have been found for the holdings. There are in Caithness and Orkney many land-seekers, who are prepared to work a "one-pair-horse" farm.

The most difficult part of land settlement in the crofting counties still remains to be described. I refer to the so-called

relief of congestion as it exists in the Hebrides and certain parishes on the west coast of Sutherland and Ross-shire—for Lochaber and Argyll were and are free from parishes of this type.

In the islands the Long Island or Outer Hebrides, parts of Skye and Tiree have required most attention.

Shetland stands by itself, being an island district of small crofters' holdings with scattalds or common grazings, and numbers of crofter fishermen. It is a better Lewis—better because there is less purely peat moss land, more soil in the narrow valleys, the housing is better, and the crofter fishermen are better fishermen and do more fishing on their own than the Lewismen. So far only enlargements of existing crofts have been made in Shetland. Probably, however, apart from land settlement, much good has been done by the efforts of public departments and the North of Scotland College of Agriculture to improve the breeds of Shetland stock—ponies, cattle and sheep—and the character of the agriculture.

With regard to the Hebrides it may be said that for various reasons very little land settlement has been carried on in Lewis and Harris, which are the worst off of all the congested districts. Most has been done in Barra, South Uist, the north end of Skye and Tiree—partly because at one time or another a great deal of discontent and agitation in those districts forced the Government of the day to do something. Thus the Barra cottars began to stir after the Boer War. A distinction has usually been drawn in these areas between fishermen's holdings, which include a dwelling-house, a cow's grass, and a patch for oats and potatoes—such as elsewhere would be called an allotment—on the one hand, and a croft intended more or less to support a family.

The neighbouring islands of Barra and South Uist offer rather well-contrasted examples of the two types. The Barra man is supposed to be a fisherman; a number of fishermen's holdings has been made in Barra and Vatersay on the lands bought by the Congested Districts Board. The large farm of Eoligaray, which has been bought by the Board of Agriculture lately, will be settled by crofter fishermen.

The number of landless cottars was relatively less in South Uist than in Barra, but a number of farms have been subdivided—in fact, there are only two or three farms at the north end of the island still left.

Probably in all the Hebridean districts the people of the Uists and Benbecula are the best farmers among the crofters. They manage stock better than most of their class and have a great aptitude for raising West Highland cattle. There is indeed no particular reason why these islands should be given up mainly to sheep, seeing that there is a more generous allowance of low ground on them than in most Highland parishes—such low hills as exist are mainly on the east side—the rest of the land is cultivable moor and “machar,” and that is cultivable if due precaution is taken. Of course sheep fed on machar make good mutton, like the French “*pré-salé*.”

One of the most ambitious schemes of the Board of Agriculture was carried out on three farms on the northern half of South Uist.

A number of quite fair-sized holdings was made on them with 25 acres of arable land, exclusive of outrun and a share in common grazing. The settlement has been well conceived and successful. When holdings of this size come to be made and there are enough people of sufficient substance to take them, they tend to create a standard and the next generation will not be content with life on a mere cottar holding. The growth of this feeling probably accounts for a diminution in the population of North Uist and Benbecula. At an earlier date the proprietor of North Uist set his face against subdivision and subletting, and in the long run his policy has been justified.

Tiree is another island of which the inhabitants are good at stock raising—ponies and cattle are their main stand-by. As the island is quite flat, the rain-clouds from the Atlantic pass over it, and its climate is drier than that of most of the west coast, but the winds are strong. Most of the farms in the island have been broken up. Some quite good holdings have been formed on the subdivided farms.

Skye is an island with contrasts. The east end has good crofts and the seven miles between Kyleakin and Broadford village probably has more modern houses than any similar area in the crofting counties. Yet there are some miserable townships even in the east part of the island, such as Sconser, and one or two on the west coast of Sleat, while in some of the northern peninsulas the crofter settlements not long since were not far ahead of the Lewis and Harris townships. Purchases by the Congested Districts Board of the Kilmuir Estate and of Glendale in the Vaternish peninsula have led to great improvements in these districts, and lately the Board of Agriculture has acquired great tracts of land in Skye—particularly a large area with some of the best land in the island round Loch Bracadale, including two great sheep farms. It will be a pity if in the settlement of these lands the Board are not able to bring the Skyeman up to a higher level of farming than is represented by club sheep stock and West Highland stirks. The grazing is good, and Ayrshire cattle can thrive in the island. Co-operative dairying for cheese-making would raise the whole level of farming in this region.

Lewis and Harris suffer from literal congestion. The 30,000 people in Lewis (apart from 4000 in Stornoway) live in a hundred township villages round the coast of the island, there being hardly any inland townships, except so far as those at the head of Loch Roag, which runs several miles inland, and again on the east side at the head of Loch Erisort can be so considered. In some respects Harris is worse off than Lewis. Like the rest of the Long Island, Harris has all its good land on the Atlantic side, and on the Minch side the land is much more rocky than in the Uists, yet it is among these rocks that the greater part of the population of Harris lives. What makes the situation worse in South Harris is that a great part of the machar grazing is not even in a sheep farm, but in a deer forest—and in the height of summer the deer may be seen on the low ground, just as they may be in the deer park at Magdalen College, Oxford, and other places in the south of England. In all the years in which statutory powers have existed for the

purpose, practically nothing has been done to make more land available for the Harris crofters. Having been forced by their environment to become crofter fishermen, they have not now the means or training to use the machar land as the Uist men would use it.

Mention should be made of a successful little settlement made by the Congested Districts Board at Borve in Bernera in the Sound of Harris.

In Lewis again, if all the farms in the island were broken up, and formed into groups of quite small crofts, the congestion would not be relieved. Until 1912 there was no power to take land by compulsion, and presumably there was some unwillingness to press the late proprietor to break up farms. The rates were very heavy, especially the parish rates. The Public Health Rate was at its statutory maximum. The services maintained out of the proceeds of local taxation were mainly for the benefit of a poor crofter and cottar population. The farms, salmon fishings and shootings represented two-thirds of the assessable rental of the island, and they were more or less free revenue, but if the farms were broken up into crofts the income would be less secure and would be saddled with the burden of a larger crofter population than ever.

Major Matheson, however, did break up the farm of Aignish, near Stornoway, into twelve or thirteen holdings in concert with the Congested Districts Board, and Mangursta over on the west side of the island in the parish of Uig. The Board of Agriculture had also scheduled four farms for subdivision before the war and had applied to the Land Court for Orders, but the disposal of the applications was hung up during the war and they have not been proceeded with since.

The recent controversy between Lord Leverhulme and the raiders has brought out the difficulties inherent in any attempt to deal with a population like that of the island of Lewis. The average Lewis croft is rented at less than £2 a year. Such a croft does not occupy the crofter for more than a fourth of the year. If he can get work for the other three-fourths, well and good. He is a migratory labourer like the Irish from Donegal and Galway, or like Poles, Italians and Spaniards. It is better that he should have his home in Lewis than in the slums of Glasgow. But clearly only a limited number of people can live under such conditions—and the Lewis tradition has been to break up small crofts into smaller ones by allowing a son or son-in-law to build a house on the croft. Hence there are 1500 families of cottars and squatters besides the 3000 families of statutory crofters.

Further, this style of life condemns the inhabitants to a low standard of living. Even now, after much rebuilding, the old black house with the byre under the same roof as the dwelling-house is painfully common.

Much public money has been spent in road-making in Lewis; and the utility of the road has come to be secondary to the desirability of circulating money in wages. The roads are not kept up after they have been made. Indefinite subsidies of this kind are too much to expect from the State. If the crofter system as it

exists in Lewis is to be maintained by Statute, and even against Statute, the local community cannot expect to be borne on public funds because they insist on sticking to an uneconomic way of living.

At the same time it is clear that the Lewis people generally would not accept employment in any industrial undertakings started in the island, which involved their forsaking their crofts. The position of an ordinary town worker working for wages and paying for the satisfaction of all his needs in cash is alien to their habit of mind. They could not be induced to give up the croft, which, humble and uneconomic as it may be, represents to them something on which they can fall back and which will see them through. They would feel that they were forfeiting their independence if they gave it up. Nor need this happen. For if the proposals for Lewis are mainly the setting up of factories in which fish can be treated, the islanders could fish in home waters, knowing that they would have a market at their doors. This opening, however, would be available mainly for the townships on the east side of the island. And it so happens that two of the bad congested areas are on that side.

The Point district, near Stornoway, contains a number of townships in which there are numerous cottars. This group of townships contains more regular fishermen than most of the island, and as Stornoway becomes more industrial these fishermen will have a local market. If these fishermen became such in the sense in which the men of the Moray Firth villages are fishermen, it would be a fairly simple thing to provide the cottars with small allotments—for they would still want a patch to grow potatoes and a cow's grass to provide them with milk—and otherwise let them live on their fishing.

The situation at the north end of the island would, however, still require to be dealt with. At present there is a more or less continuous line of houses along the highroad on the west coast for about two miles out of Ness, the most northern point, and a little south of this series of settlements are a few badly congested townships to relieve which portions of the common grazings should be made available, even if the sheep farm of Galson is not taken for this purpose.

Looking at land settlement in the Hebrides, one may say that here it will probably have one result—*i.e.* that in time very little but crofters' holdings will be left in most of these islands; and on the whole settlement has not been very expensive to the tax-payer here. It is true that the Boards concerned have had to let land at a lower rate than they purchased it at, but only in one scheme have they had to pay a heavy compensation.

One of the grounds for claiming cheapness as a merit of Hebridean schemes is that buildings are put up in these districts more cheaply than elsewhere in Scotland. The crofter has one quality of a good colonist—he is a jack of all trades. He gets in a local mason, and perhaps a joiner and slater, and among them they soon put up a dwelling-house; the byre is a still simpler matter. It is unfortunate that on the mainland the crofters with rather larger holdings seem to have lost this power, and apparently

the local working tradesman is less common in the more eastern districts. Anyhow, houses on settlements in these parts usually have to be built by contract, which is a pity, because the whole success of the crofter type of small holding is based on the fact that the buildings are provided by the crofter. They can be so provided effectively only if something like the Hebridean practice survives; otherwise they will be too big a burden and will tend to make impossible the type of small holding which has so far survived in the crofting districts.

To turn now to the rest of Scotland. It was suggested at the outset that land settlement is on a different footing here from the crofting districts. Not that the rest of Scotland, which goes from Rattray Head to Kirkmaiden, is quite uniform. But what one might call a social equilibrium has been established in most of the other parts of Scotland.

The majority of the people in the rural districts acquiesce in the existing disposal and distribution of land. Indeed in many parts of Scotland the type of small holder corresponding to the crofter has died out, and the system with which he was associated has been so thoroughly superseded that, in the ranks of society which replaced him, nobody represents the succession and therefore nobody feels disinherited. Over great tracts in the south-east of Scotland there is nothing but arable farms, with large farmers and skilled workers. Such villages as exist are inhabited mainly by such tradesmen as are still required for a country-side, which has hardly any peasantry apart from the farm worker.

Again, over the whole stretch of hill country from St. Abbs Head to Ballantrae is a nearly continuous zone of hill sheep farms inhabited solely by the tenants and the shepherds, many of them led farms and in that case entrusted very much to the shepherds. The same state of things reproduces itself again in the Grampians, from the Firth of Clyde almost to Aberdeen. Except that in parts of the Grampians sheep farms have given place to deer forests, it seemed part of the settled order of things that these tracts of land would never be put to any different use than sheep farming, unless it were to provide sport, and that the social organisation of their population would never change. Fife, East Perth and Forfar again are rather like the Lothians, except that in some districts the cultivation is less intensive and more cattle are fed.

Farther north, in Aberdeen and Banff, highly efficient mixed arable farming and stock feeding are achieved, but under a rather different system. This is the region of the efficient and economic small farm—something like a Scottish Denmark.

The south-west again—Lanark, Ayr and Dumfries—has its arable districts and its dairy farms. What is wrong, it might be asked, with the existing order of things? Soil, climate and markets have determined the right kind of farming for the different regions of the country, and the right size of farm for each type of farming. No doubt there is much truth in all this, and probably the best and most suitable thing has been done with the various districts—so well planned indeed and business-like does everything seem that to a stranger from England most of the country

districts in Scotland give a peculiar impression of being labelled "no admittance except on business." It is true that in certain districts with unusual amenity a certain number of "summer letting" village communities are tolerated and townspeople are allowed to come into them during the summer. Hence, given this matured and four-square system, any one that proposed to settle people on the land and break up farms into small holdings in the non-crofting parts of Scotland is regarded as an innovator—and one who is proposing to put to a less useful purpose the much prized but limited farm land of Scotland. It is not realised that there is nothing "static" in this world except perhaps an Australian marsupial. If it will help to disarm criticism, it may be said at once that probably nobody has ever proposed to convert large farms into small holdings on a big scale in any of the well-farmed areas of Scotland. Further it will probably be generally conceded that unless such subdivision at least keeps up the level of agricultural production on the land, there will have to be strong social grounds for making the change in order to outweigh the purely agricultural considerations against it.

It may be suggested that the war has satisfied many people that such social reasons do exist. Under certain circumstances land settlement does lead to increased agricultural production. The success of ordinary Scottish farming depends on a supply of skilled labour as well as of skilled capital. In the years before the war there was a large emigration of farm workers, and farms in arable districts were being put down to grass through sheer scarcity of labour. Now, sufficient labour could be ensured by making farmer and labourer one—*i.e.* by breaking up a large farm into smaller farms. Scottish experience is not unique here. Scarcity of hired labour has caused the formation of small farms in France, America and elsewhere. The farm of Middlebank in the parish of Errol, Carse of Gowrie, was a farm in this position, which was taken by the Board, and it has been one of their most successful settlements, and the production of the area has increased.

Even apart from this consideration the emigration of farm workers brings out one of the chief motives for providing means for the formation of small holdings. It was hoped in fact to make home prospects brighter for this class, among whom there was clearly some discontent with their lot in life. From this point of view the small holdings movement should have commended itself more to large farmers than it has done. Who could be more competent than a hill shepherd to take up a sheep farm? Yet the ordinary sheep farm requires too much capital for a shepherd to hope to offer for one. Indeed, if he is to bring up a family on his wages, he can save little even for a single hirsel farm, and few such exist. It is indeed probably the lack of working capital which has made it difficult so far for farm workers to apply for small holdings. For the Board has set itself generally in the east and south of Scotland to create fair-sized small farms, at least of the "one pair" of horses type. They knew that a farm worker was too well aware of the conditions of farm work to want to take an uneconomic small holding—and even for the small farm of 60 to 100 acres a fair capital is required. Such farms are not

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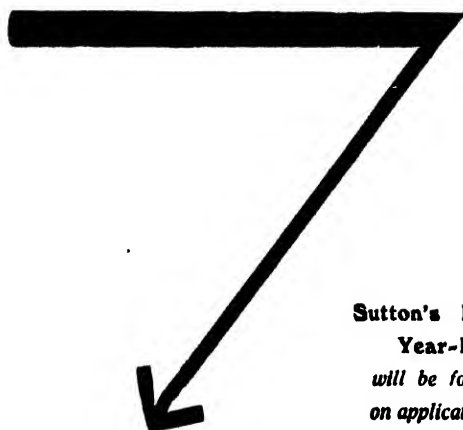
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uncommon in the counties between the Tay and the Moray Firth, but they are usually up the glens and rather far from centres. Further, it is clear that there is a demand for such farms, since, whenever one falls vacant there are usually numerous offerers. In Aberdeen and Banff even on lower ground, small farms and small holdings are common. Aberdeen has as many small holdings of not more than fifty acres as Inverness. Hence in Aberdeen there is no great need for more small holdings. Nor is there such land hunger among the small holdings population here as in the crofting counties. The families of the Aberdeenshire small farmer have a wider outlook, they are well educated, and can push their fortunes outside their native parish.

There is another class of demand, the satisfaction of which might perhaps be watched rather critically in some quarters—*i.e.* the demand of the town dweller for a small place in the country with a little land, where he can be something of a market gardener or can keep pigs and poultry. Such a person has often had little experience of country life, and to-day the high cost of building makes it doubtful whether too much money should be spent on forming holdings of this kind, which may perhaps soon disappoint their occupiers. Places of this kind, too, are more readily provided in districts with numerous villages, such as are common in the south of England. But in Scotland land is limited and usually earmarked for existing farms. Still, the fact of the war and the considerable number of ex-soldiers, who represent this type of demand, make it impossible to ignore it.

Small holdings of this type have been made—*e.g.* in Ayrshire—on which the work is done by the holder's family, while he works mainly elsewhere. A critic might say that this was rather helping to provide housing (with a large allotment) for farm workers, and making them more like the English agricultural labourer, who is a cottager. Few market gardens have been formed under the Act of 1911, the farm of Ballencrieff in East Lothian being the settlement on which most have been made. During the two years at which they were at work before the war, the Board of Agriculture were not able to do much in the non-crofting counties; a few schemes in the Border counties, one or two, not too successful, in the Lothians, one good one in East Perth, and several in the south-west were their main achievement. The Small Holding Colonies Act, 1916, and the Scottish Land Settlement Act, 1919, however, have enabled them to work on a larger scale, substituting for previous methods the purchase of whole estates and for this purpose providing more liberal funds than were previously available. In this way estates have been acquired in the counties of Aberdeen, Kincardine, Forfar, Perth, Fife, Berwick, Dumfries, and single farms in East Lothian, Ayr and Argyll (Kintyre). An estate on the borders of Aberdeen and Banff was presented to the Board free by the owner for settling natives of Aberdeenshire. On some of the estates central farms and other training institutions are being established.

The policy of purchasing land, however, has its drawbacks, which, like those attending the working of the 1911 Act, are largely financial. Curiously enough, the "Wyndham" Act in

Ireland, which definitely substituted a scheme of purchase for the Gladstonian legislation of 1881, was soon held up by the financial break. Purchase means locking up capital in land, some of which will not become available for several years, as the farm leases run out—for it is an expensive business to compensate existing tenants for breaking their leases.

These considerations tend to slow down the pace of land settlement—but this will not be an unmixed evil, if it causes half-hearted applicants to cry off. And among ex-service men there must be a certain number of applicants who are at a loose end through no fault of their own, but in many cases in fact through their public spirit and devotion to national need, which has interrupted the thread of their former civilian life. The country has an obligation to them, but the best way of meeting it is not necessarily through the provision of a small holding.

The great bulk of the demand for land still comes from the crofting counties, but in the rest of Scotland there is a marked demand from certain districts, such as the counties of Ayr, Dumfries, Lanark, Wigtown, in the south-west, Perth, Fife and Berwick on the east. The distribution of demand is interesting. It is strongest in the south-west. This is not surprising, as Ayr and Lanark are near great markets and they are dairying counties with great numbers of small dairy farms at present. Dairying indeed is one of the obvious openings for the small farmer. Dumfries, again, is a county in some parishes of which there are already numbers of successful small holdings, worked on a combination of two or three lines, which favour the small holder. Among the early settlements of the Board some of the most successful have been in Dumfries and Wigtown. In the latter county a good class of applicant has come forward. Dairy holdings have formed a feature of the settlements in the south-west, and dairy herds of 24 or 25 cows may be found on holdings of 60 acres. Any agriculturist might without misgiving support the formation of small places in the south-west of Scotland, and it is obvious that the increase of dairying, especially co-operative dairying, in this region, indicates actual agricultural progress.

The eastern counties in which a demand exists are noteworthy as being centres of high arable farming, and the skilled ploughman is common in them. They, too, are near good markets, and as fair-sized holdings will generally be made in these districts there seems to be a good chance of land settlement, the results of which the promoters need not be ashamed of even in the very centres of high farming.

WAGES OF FARM-WORKERS IN 1920-1921.

SIR JAMES WILSON, K.C.S.I.

I.—BERWICKSHIRE.

RETURNS have been received from 66 farms in different parts of Berwickshire stating for each worker his or her age, present cash wages and allowances in kind. The cash values of the

allowances in kind has been calculated at the values placed upon them for the purposes of the minimum wage by the District Wages Committee, the most important of those values being as follows :—

House as entered in the Valuation Roll.

Dressed potatoes, £9 per ton.

Potatoes in the drill, £6, 15s. per 800 yards.

Milk, 2s. 6d. per gallon.

Oatmeal, 4s. 9d. per stone.

Cartages, £2 per annum.

Keep of a cow on low land, 9s. per week.

Keep of a hill shepherd's cow, 4s. per week.

Board and lodging, men over 18, 21s. per week ; women over 17, 14s. per week.

For each class of worker an arithmetical average has been struck. Practically all the permanent staff are engaged for the year, and these arithmetical averages give a fairly accurate idea of the actual earnings of the farm-workers in the county during the current year commencing with Whitsunday 1920.

Total Permanent Farm Staff.—The farm-workers permanently employed on these 66 farms (excluding domestic servants) may be classified as follows :—

Class of Worker.	Under 21.		Between 21 and 60.		Over 60.		Total.		
	Married	Single	Married.	Single	Married	Single	Married	Single.	Total.
Stewards	27	...	9	...	36	...	36
Ploughmen	25	87	55	5	..	92	80	172
Cattlemen	1	21	5	6	...	27	6	33
Shepherds	3	30	2	2	...	32	5	37
Orramen	3	11	1	3	3	14	7	21
<i>Total Male Workers</i>	32	176	63	25	3	201	98	299
Woman Workers	30	8	72	...	...	8	102	110
<i>Total both sexes</i>	62	184	135	25	3	209	200	409

Of the total permanent working staff on these farms 27 per cent. are women and girls. Of the male workers 67 per cent. are married ; 11 per cent. are under 21 ; 80 per cent. are between 21 and 60 ; and 9 per cent. are over 60. Few youths under 21 are employed as cattlemen, shepherds or orramen, but 15 per cent. of the ploughmen are under 21.

All Male Farm-Workers.—The average weekly earnings of all male farm-workers, without distinction between married and single, are as follows :—

AVERAGE TOTAL WEEKLY EARNINGS.

Class of Worker.	Under 21.	Between 21 and 60.	Over 60.
	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>
Stewards ... ..	...	61 1	59 0
Ploughmen	47 6	52 6	52 10
Cattlemen	48 7	54 0	50 4
Shepherds	46 4	56 4	52 9
Orramen	43 1	49 10	49 0

In all classes the average earnings of the youths under 21 are at least 5s. a week less than those of the adults between 21 and 60, and in all classes except the ploughmen the earnings of the men over 60 are somewhat lower than those of the men between 21 and 60. In the case of the men between 21 and 60 the average earnings of the shepherds and cattlemen are higher than those of the ploughmen, while those of the orramen are lower; but it is to be remembered that out of his earnings the shepherd has generally to feed one or more dogs. The average earnings of the stewards are 8s. 7d. a week more than those of the ploughmen.

Average Weekly Earnings of Men between 21 and 60.—The average weekly earnings of the men between 21 and 60, other than the stewards, are as follows:—

Class.	Married.			Single.		
	Cash Wages.	Value of allowances.	Total.	Cash Wages.	Value of allowances.	Total.
	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>	<i>s.</i> <i>d.</i>
Ploughmen ...	44 10	9 5	54 3	44 0	6 0	50 0
Cattlemen ...	44 9	10 10	55 7	42 1	5 1	47 2
Shepherds ...	45 1	11 9	56 10	38 0	11 5	49 5
Orramen ...	44 7	6 9	51 4	33 0	0 9	33 9

In all classes the average earnings of the single men are below those of the married men by 4s. a week or more, the difference being mainly in the value of the allowances, except in the case of the shepherds and orramen. For the married men between 21 and 60, the average cash wages are much the same for all classes, but the shepherds and cattlemen have higher, and the orramen lower, allowances than the ploughmen.

Married Ploughmen between 21 and 60.—The most important class of workers on these farms is that of the married ploughmen between 21 and 60, and the information regarding them may be given in more detail. The married ploughman is in almost every case provided with a house and with certain allowances, including the free cartage of his coals and flitting. Of the 87 married

ploughmen almost every man receives an allowance of potatoes, sometimes in the form of so many cwts. in the year and sometimes as the produce of so many yards of drill. Thirty-five men get potatoes by weight, 22 of them receiving 2 tons, one 30 cwt., eight 1 ton, and four 16 cwt., so that the typical allowance in this form may be taken to be 2 tons in the year. When the allowance is made in yards of drill, the man supplies the seed and the farmer supplies the land, manure and labour. Of the 48 men who get their potatoes in this form, 22 have 1800 yards of drill and 21 have 1600 (about a quarter of an acre). Only 4 of the 87 get an allowance of oatmeal, varying from 10 to 24 stones in the year. None of them has a daily free allowance of milk, but 10 have the keep of a cow. Of the 87 men at least 42 have a harvest-fee, of whom 3 get £3, 13 get £2, 20 get 30s. or 35s., and 6 get £1. The man who can supply one or more workers generally gets a higher wage than the man who cannot. The present average earnings of a typical married ploughman in this county may be reckoned as follows:—

<i>Earnings</i>				<i>Per Year.</i>			<i>Per Week.</i>	
				£	s.	d.	s.	d.
Cash Wage	...	...	...				45	0
Allowances—								
House and garden	...	...	...	5	0	0		
1800 yards of potatoes	...	...	...	15	4	0		
Cartages	...	...	...	2	0	0		
Harvest fee	...	...	...	2	0	0		
Total of allowances				£24	4	0	9	4
				Total earnings			54	4

Where a ploughman has the keep of a cow his cash wage will be 9s less. Of the 87 married ploughmen 20 have total earnings of over 56s. a week and 13 have under 52s., but only 7 have over 58s. and only 4 less than 50s. As there must be a considerable difference in the efficiency of the different men, and as the earnings in each case are the result of an individual bargain, it is somewhat remarkable that the difference in earnings is not greater.

It is interesting to compare the present figures with those given for the average earnings of adult horsemen (married and single) in the Board of Trade's Report of 1907 and with the corresponding figures based on a partial inquiry made last year.

Year.	Class.	Average Weekly Earnings.		
		Cash.	Allowances	Total.
		s. d.	s. d.	s. d.
1907	Adult horsemen	16 7	3 0	19 7
1919-20	All ploughmen between 21	39 3	7 7	46 10
1920-21	and 60.	44 6	8 0	52 6

According to these estimates, the present cash value of the average earnings of an adult ploughman is about 2·7 times what it was 13 years ago, and 5s. 8d. a week higher than it was last year. For the married ploughman the comparison with last year is as follows:—

Year.	Average Weekly Earnings of Married Ploughmen between 21 and 60.		
	Cash.	Allowances.	Total.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
1919-20 ...	39 5	9 2	48 7
1920-21 ...	44 10	9 5	54 3

In last year's calculations, which were for the winter half-year, the harvest-fee was not taken into account, and, allowing for this, the rise in the average total earnings this year has been about 5s. a week. At a joint conference between the Farmers' Union and the Farm Servants' Union for Middle and East Berwickshire held before last Whitsunday it was agreed to recommend a rise of 4s. 6d. a week, and it now appears from these returns that that recommendation has been generally followed, at all events on these 66 farms.

Other Men between 21 and 60.—The comparison is as follows for all men, married and single, between 21 and 60:—

Year.	Total Weekly Earnings.		
	Cattlemen.	Shepherds.	Orramen.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
1907 ...	20 6	21 8	20 4
1919-20 ...	48 7	51 2	45 10
1920-21 ...	54 0	56 4	49 10
Increase since last year ..	5 5	5 2	4 0

The rise of wages since last year appears to have been approximately the same for these classes of workers as for the ploughman.

The allowances of the married cattlemen are much the same as those of the ploughmen. Of the 21 married cattlemen between 21 and 60, 11 get an allowance of potatoes by weight—generally 2 tons; 7 get so many drills of potatoes—generally from 1200 to 1800 yards; 5 have the keep of a cow; 7 have a harvest-fee varying from £1 to £3; and 2 at least are allowed to keep pigs.

Of the 30 married shepherds between 21 and 60, 11 get an allowance of potatoes by weight, of whom 6 get 2 tons and four 1 ton yearly. Twelve get so many drills, 5 getting 1800, and 5 1600; 12 get an allowance of oatmeal or barley, the highest allowance being 60 stones per annum. Fifteen of them get the keep

of a cow; 5 have an allowance of coals, generally 1 ton per annum; and 6 get a harvest-fee varying from 30s. to £3. Five are allowed to graze sheep, in one man's case the number being 10 ewes and 3 hogs, but it is generally less—say 3 or 4 ewes.

Of the 11 married orramen between 21 and 60, 8 have an allowance of potatoes by weight, generally 1 or 2 tons; 1 has 1600 yards and another 1200 of drill; 1 is allowed the keep of a cow, and 4 get a harvest-fee.

Single Men and Boys.—Of the whole male staff on these 66 farms one-third are single men and boys, and of them one-third are under 21. There is no mention of a bothy on any of these farms, and in only three cases is the man returned as getting his meals in the farm-house. A considerable number of single men have a free house, and probably in these cases the man has a mother or sister living with him. The great majority of the single men and boys apparently live with their relatives, and some of them get an allowance of potatoes as part of their wages.

Female Workers.—On these 66 farms the number of women and girls permanently employed (other than domestic servants) is 110, of whom only 8 are married; 30 of them are under 21. For the 80 women between 21 and 60 the comparison with last year is as follows:—

Year.		Cash.		Allowances.		Total.	
		s.	d.	s.	d.	s.	d.
1919-20	...	24	5	1	7	26	0
1920-21	...	29	2	3	1	32	3

In the calculation made last year, which was for the winter half, the harvest-fee was not taken into account, and, if allowance be made for that, the rise of earnings seems to have averaged about 5s. 6d a week, or much the same as for the men. Of the 110 female workers 52 get in cash 30s. a week, 33 get 29s. or 29s. 6d., and 20 get 28s. or 28s. 6d. In addition to this regular cash wage almost all the women get a harvest-fee, which in most cases is £2, but in some cases is £1 and in others £2, 5s. or £3. A number of the women workers have a free house, some of them being widows with children, and some of them sisters living together, and in such a case the woman usually receives an allowance of potatoes similar to that of the married man. It is not usual to lodge and board the women workers in the farm-house. Most of them live with their parents or relatives, and in such cases they generally get an allowance of potatoes, such as a ton or 900 yards of drill. At the joint conference held before last Whitsunday it was recommended that for Middle and East Berwickshire the cash wages of women should be increased by 4s. 6d. a week, and it now appears that this recommendation has been generally followed.

Family Engagements.—On many farms in this county the size of the cottages makes it possible for a family to live together and work on the same farm, the bargain being often made with the

father or elder brother for the whole family. For instance, on one farm with a permanent staff of 14 male and 7 female workers, to judge from the names, three families provide 4 workers each, and other two provide 3 each. On another farm with 8 males and 3 females, 10 of the workers are provided by three families. On another farm, again, a ploughman and his son and daughter are engaged together and so are another ploughman and his two daughters. It is common for some of the sons and daughters, even after they are grown up, to stay on in the family home and work on the farm the whole year round along with their father.

Working Hours.—In February 1920 a joint recommendation was issued by a conference between representatives of the two Unions in Berwickshire as to the basis on which re-engagements should be made at the ensuing hirings:

That the working hours be 9 per day, from stable to stable, from 1st February to 15th November, except during harvest, when the present arrangement as to working hours will be continued.

That the working hours from 16th November to 1st February be 8 hours per day, from stable to stable.

Any meal-times taken will be reckoned as an addition to these hours. There shall be allowed 17 whole, or 34 half, holidays, with New Year's Day and one hiring day in addition.

II.—BUTE AND ARRAN.

Similar returns have been received from 32 farms in Bute and Arran (14 from Bute and 18 from Arran). The most important of the values placed on the allowances are as follows:—

House and garden—Per Valuation Roll, and failing any entry in the Valuation Roll such value as may be fixed by the District Committee, but in no case to exceed £6 per annum.

Oatmeal—43s. per boll of 140 lbs.

Flour—25s. 6d. per boll of 140 lbs.

Potatoes—£6 per ton.

Milk 2s. per gallon.

Butter—2s. per lb.

Board and lodging—Males over 18—16s. per week.

Females over 18—13s. per week.

Coals—£2 per ton.

Peats—£6 per annum for the customary supply for a year's fuel (the farmer bearing the expense of cutting, carting, and stacking peats).

Free cartage—Usual rate and custom, but not exceeding £1 per annum.

For each class of worker an arithmetical average has been struck. As a general rule the married men are engaged for a year from Whitsunday, but sometimes in Arran from Martinmas, and the rest of the farm staff are engaged for the half-year from Whitsunday or Martinmas, so that in most cases the wages now paid (October 1920) were fixed at last Whitsunday.

Total Permanent Farm Staff.—The farm-workers permanently employed on these 32 farms may be classified as follows:—

1921]

WAGES OF FARM-WORKERS, 1920-1921.

1 steward, 30 ploughmen, 5 cattlemen, 8 shepherds, 20 orramen, and 25 women and girls, some of whom do domestic as well as farm work. This makes a total permanent staff of 89—giving an average of less than 3 per farm. The women and girls, including those who are part-time farm-workers, comprise 28 per cent. of the total. Of the 64 male workers 15 are under 21 and 49 over 21; 31 are married and 33 are single.

Male Farm-Workers.—In all classes the average earnings of the youths under 21 are considerably less than those of the adults between 21 and 60. For the adults the comparison is as follows:—

AVERAGE WEEKLY EARNINGS OF MEN BETWEEN 21 AND 60.

Class.	Married.			Single.		
	Cash Wages.	Value of allowances	Total.	Cash Wages.	Value of allowances	Total.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Ploughmen ...	46 6	8 4	54 10	30 10	14 7	45 5
Cattlemen ..	25 0	32 0	57 0	23 2	15 6	39 8
Shepherds ..	36 7	14 5	51 0	...	...	...
Orramen ...	37 0	9 10	46 10	23 0	13 10	36 10

In all classes the average earnings of the single men are below those of the married men by 9s. a week or more. In the case of the married men the average earnings of the shepherds are 3s 10d. a week below those of the ploughmen, and those of the orramen are 8s. a week below those of the ploughmen.

Married Ploughmen between 21 and 60.—The most important class of workers on these farms is that of the married ploughmen between 21 and 60. Bute is less Highland in character than Arran and lies nearer the mainland, and the statistics regarding these two islands may be given separately.

AVERAGE WEEKLY EARNINGS OF MARRIED PLOUGHMEN
BETWEEN 21 AND 60.

Ireland.	Number of Men.	Cash Wages.		Value of allowances.		Total
		s.	d.	s.	d.	s. d.
Bute ...	9	47	5	11	10	59 3
Arran ...	10	45	8	5	1	50 9
	19	46	6	8	4	54 10

It appears that both the cash wage and the allowances are on a more liberal scale in Bute than in Arran. The married ploughman is in almost every case provided with a house and with the free cartage of his coals and flitting. In Bute each man gets an allow-

ance of potatoes by weight, varying from 6 to 20 cwts. in the year, the typical allowance being 15 cwts. Of the 9, 4 get 20 stones of oatmeal per annum and 1 gets 10 stones; 8 of them have an allowance of milk per day—generally 4 pints; 2 of them get 2 tons of coal per annum, and 2 of them have one or two meals daily. The present average earnings of a typical married ploughman in Bute may be reckoned as follows:—

<i>Earnings.</i>			<i>Per Year.</i>	<i>Per Week.</i>
			£ s. d.	s. d.
Cash Wage	...	...		47 0
Allowances—				
House	...	...	4 0 0	
Oatmeal (20 stones yearly)			4 6 0	
Milk (4 pints daily)	...		18 5 0	
Potatoes (15 cwts. yearly)			4 10 0	
Cartages	...	...	1 0 0	
Total allowances	...		£32 1 0	12 4
			Total earnings	<u>59 4</u>

In Arran all the married ploughmen get an allowance of potatoes, 5 of them getting potatoes by weight, averaging about 15 cwts. in the year, and 3 of them each get 800 yards of drill. Of the 10, 5 get an allowance of oatmeal averaging about 20 stones in the year; 4 of them get 2 pints of milk daily, in one case the milk being skim milk. The present average earnings of a typical married ploughman in Arran may be estimated as follows:—

<i>Earnings.</i>			<i>Per Year.</i>	<i>Per Week.</i>
			£ s. d.	s. d.
Cash Wage	...	...		42 0
Allowances—				
House and garden	..		4 0 0	
Oatmeal (20 stones yearly)			4 6 0	
Milk (2 pints daily)	...		9 2 0	
Potatoes (15 cwts. yearly)			4 10 0	
Cartages	...	...	1 0 0	
Total Allowances	...		£22 18 0	
			Total earnings	

Of the 9 married ploughmen in Bute 6 have average earnings exceeding 60s. a week, and of the 10 in Arran 5 have less than 50s. For the adult ploughmen (married and single) the comparison with the results of previous inquiries is as follows:—

Year	Class.	Average Weekly Earnings.		
		Cash.	Allowances.	Total.
1907	Adult Horsemen	s. d. 13 11	s. d. 5 2	s. d. 19 1
1919-20}	All Ploughmen between 21	30 0	15 6	45 6
1920-21}	and 60	42 3	10 0	52 3

So far as these figures go, the present cash value of the average earnings of an adult ploughman in Bute and Arran is about 2·7 times what it was thirteen years ago and 6s. 9d. a week higher than it was last year; but the number of men is too small on which to base an accurate comparison. Most of them seem to have been given a rise at last Whitsunday of 4s. or 5s. a week.

Shepherds and Orramen.—Of the 6 married shepherds (all in Arran) 3 have each in the year 85 stones of oatmeal or flour, 1600 yards of potatoes and 5 tons of coal; 2 have the keep of a cow.

Of the total male staff of 64 on these farms, 20 are not in special charge of animals, and have therefore been classed as orramen. Of these 20, 16 are single and 9 are under 21. Some of them are partly employed in distributing milk, but most of them are young lads learning farm-work or engaged to be of general use on the farm. Practically all the single men and lads are boarded and lodged on the farm, and there is mention of only one bothy. The value placed by the District Committee on board and lodging of males over 18 is 16s. per week, which is lower than in most other districts, and possibly this may have led to an under-valuation of the allowances of the single men as compared with those of the married men.

Women and Girls.—On these 32 farms the number of women and girls permanently employed is 25, of whom only 2 are married; 11 of them are under 21. They are almost all engaged by the half-year. Very few of them are outworkers, the 2 married women so employed having wages of 5s. and 5s. 6d. per day. The single women and girls are practically all boarded and lodged in the farm-house, and the value placed on board and lodging of a woman over 18 has been fixed by the Wages Committee at the low rate of 13s. a week. The cash wage of the 12 single women between 21 and 60 averages 18s. 9d. per week. This gives the average value of their total earnings as 31s. 9d. Most of them seem to have had a rise of cash wages last Whitsunday varying from 1s. to 4s. and averaging about 2s. per week. (Their wages, however, are generally fixed as so many pounds per half-year.) Few women are employed in farm-work in Arran, but in Bute a number are employed as dairymaids or byre-women, and some are engaged partly to do domestic work and partly to help in the work of the farm, especially in milking. Some of them get a considerably higher cash wage than the average. Seven of the women and girls have a cash wage of £26 in the half-year or over—that is to say, their weekly earnings are not less than 33s. a week (cash 20s., board and lodging 13s.).

Casual Labour and Piece-work.—Rates recently paid in Bute for casual labour at harvest are from 40s. to 60s. per week, with board and lodging, for men, and from 6s. to 7s. 6d. per day for women. For singling turnips by piece-work the rate has varied from 4½d. to 6d. per 100 yards according to the condition of the crop.

Working Hours.—In Bute and Arran the usual custom now is to work a 9 hours' day for 6 days a week, the men getting from 14

to 20 days full holidays in the year, including New Year's Day, 2 Fast Days, and a Fair Day. On some farms the hours are from 7 A.M. to 5 P.M.; on others from 7.30 A.M. to 5.30 P.M., with one hour off for dinner. In a few cases a week's holidays are given at each term.

III.—FORFARSHIRE.

Returns have also been received from 50 farms in different parts of Forfarshire. In the north of the county nearly all the married men on the permanent staff are engaged for the year from Whitsunday, and in the south from Martinmas, while the single men are mostly engaged by the half-year. The following arithmetical averages may be taken as giving a fairly accurate idea of the actual earnings of the farm-workers in Forfarshire during the year commencing at Whitsunday 1920.

Total Permanent Farm Staff.—The farm-workers permanently employed on these 50 farms (excluding domestic servants) may be classified as follows:—

Class of Worker.	Under 21.		Between 21 and 60.		Over 60.		Total.		
	Married.	Single.	Married.	Single.	Married.	Single.	Married.	Single.	Total.
Stewards	30	...	3	...	33	...	33
Ploughmen	36	73	61	...	...	73	97	170
Cattlemen	30	5	7	...	37	5	42
Shepherds	6	2	1	...	7	2	9
Orramen	2	17	5	3	1	20	8	28
<i>Total Male Workers</i>	38	156	73	14	1	170	112	282

Of the total permanent male workers 60 per cent. are married and 81 per cent. are between 21 and 60.

Average Weekly Earnings of Men between 21 and 60.—The average weekly earnings of the men between 21 and 60, other than the stewards, are as follows:—

Class.	Married.			Single.		
	Cash Wages.	Value of allowances.	Total.	Cash Wages.	Value of allowances.	Total.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Ploughmen ...	46 10	17 8	64 6	54 2	11 7	65 9
Cattlemen ...	47 6	17 10	65 4	54 1	11 4	65 5
Shepherds ...	43 11	16 8	60 7	46 2	13 6	59 8
Orramen ...	48 11	15 2	64 1	52 10	7 6	60 4

Forfarshire is one of the few counties in Scotland in which the average earnings of the single men are much the same as those of the married men. Usually they are considerably less.

Married Ploughmen between 21 and 60.—The married ploughman is in almost every case provided with a house and with certain allowances, including the free cartage of his coals and flitting. Of the 73 married ploughmen almost every man receives an allowance of potatoes, usually amounting to one ton or one load in the year, while in a few cases a larger amount (such as 25 to 30 cwt.) is given. Nearly all the men get an allowance of oatmeal, the usual quantity being $\frac{1}{2}$ boll (5 stones) every four weeks, making $6\frac{1}{2}$ bolls (65 stones) in the year. It is customary to give a daily allowance of new milk, the quantity supplied being in most cases 16 gills (half an imperial gallon), but some get 18 gills in summer and 12 in winter. Coal is hardly ever given free, and firewood only in a few cases.

The present average earnings of a typical married ploughman in this county may be reckoned as follows:—

<i>Earnings</i>			<i>Per Year.</i>			<i>Per Week</i>		
			£	s.	d.	s.	d.	
Cash Wage	...	...	120	0	0	46	2	
Allowances—								
House and garden	...		5	0	0			
Oatmeal (65 stones yearly)			14	0	0			
Milk ($\frac{1}{2}$ gallon fresh daily)	...		20	10	0			
Potatoes (1 ton undressed yearly)	...	...	5	0	0			
Cartages	...	...	4	0	0			
Total of allowances			£ 48	10	0	18	8	
Total earnings			£168	10	0	64	10	

It is interesting to compare the present figures with those given for the average earnings of adult horsemen (married and single) in the Board of Trade's Report of 1907, and with the corresponding figures based on a partial inquiry made last year:

Year.	Class.	Average Weekly Earnings.		
		Cash.	Allowances.	Total.
		s. d.	s. d.	s. d.
1907	Adult horsemen ...	15 0	5 8	20 8
1919-20 }	All ploughmen between 21	47 3	13 6	60 9
1920-21 }	and 60... ..	50 2	14 11	65 1

According to these estimates, the present cash value of the average earnings of an adult ploughman is more than three times what it was thirteen years ago, and 4s. 4d. a week higher than it was last year. For the married ploughmen the comparison with last year is as follows:—

Year.	Average Weekly Earnings of Married Ploughmen between 21 and 60.		
	Cash.	Allowances.	Total.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
1919-20	43 3	16 2	59 5
1920-21	46 10	17 8	64 6

Grievies or Foremen.—The 33 grievies or foremen employed on these farms (all married men) had average earnings of 68s. 10d. (cash 50s., allowances 18s. 10d.), as compared with 64s. 6d. for the married ploughmen.

Other Men between 21 and 60.—The comparison is as follows for all men, married and single, between 21 and 60:—

Year.	Total Weekly Earnings.		
	Cattlemen.	Shepherds.	Orramen.
	<i>s. d.</i>	<i>s. d.</i>	<i>s. d.</i>
1907	20 6	20 6	19 11
1919-20	62 4	61 2	53 5
1920-21	65 4	60 4	63 2
Increase since last year ...	3 0	0 10 (Decrease).	9 9

The shepherds do not seem to have shared in the rise of earnings which was secured by the other classes last year.

The allowances of the married cattlemen are similar to those of the ploughmen. Of the 30 married cattlemen between 21 and 60, nearly all get an allowance of potatoes by weight—usually about 1 ton—6½ bolls oatmeal, 16 gills of milk daily, and in one or two cases from 1 to 3 tons of coal.

Of the 6 married shepherds between 21 and 60, nearly all receive the same allowances as the cattlemen, but in one case a cow is supplied.

The allowances of the married orramen are similar to those of the married ploughmen, the ordinary allowance being 16 gills milk daily, 6½ bolls meal, and 1 ton of potatoes.

Single Men and Boys.—Of the whole male staff on those 50 farms nearly 40 per cent. are single men and boys, and of them 34 per cent. are under 21. In this county it is the usual custom for the single men and lads employed on the farm to be lodged in a bothy consisting of one or more rooms, in or near the farm buildings, and to be supplied with fire and light, beds and benches, bedding and a few necessary utensils. They receive as part of their wages usually one Scotch pint (12 imperial gills) of fresh milk per day, and a quantity of oatmeal, generally half that allowed to the married ploughmen—that is, about 32½ stones

per annum. Of the 61 single ploughmen only one had board and lodgings.

Female Workers.—Very few permanent women out-workers are employed, and none are mentioned in the returns received.

Working Hours.—The ordinary working week is one of 9 hours a day, reckoned from the time the horses leave the stable to the time work stops in the field, for 5 days a week and 5 hours on Saturday, making 50 hours' week; but a shorter day is worked in winter according to the daylight. In summer the horses leave the stable at 6.30 A.M. or 7 A.M., and work stops at 5.30 P.M., with an interval of 2 hours or $1\frac{1}{2}$ hours in the middle of the day. On some farms it is part of the bargain that in harvest 4 or 6 whole Saturdays shall be worked without payment of overtime, in exchange for holidays at other times; on others Saturday afternoon work, even in harvest, is paid for as overtime at 1s. 6d. per hour. The ploughman's average working week for the year (besides overtime paid for as such) will be a little less than 50 hours, besides stable-work.

THE following account of an attempt to reclaim peat moorland in Lewis has been received from Mr D. H. Thompson, B.A., who has been in charge of the work:—

The site chosen for this experiment was a piece, some five acres in extent, on the Arnish Moor, three miles south of Stornoway. This place is typical moorland, but unusually wet and deep

Reclamation of Peat Moss on the Island of Lewis.

—so much so that even in mid-June (despite a very dry summer) there were still numerous pools and it was impossible to stand on parts of it without being "bogged" up to the knees. As the ground sloped naturally in a very gentle fall towards a stream on the north side of the moor, it was decided to utilise this stream as a "leader," and to cut all drains at right angles to it and emptying into it: this slope solved the difficulty of creating artificial gradients in the drains, and by emptying all drains direct into an open leader the use of joints and side-drains (which are always a weak spot in drainage) was avoided.

The heavy expense involved in making deep and very frequent drains was the main problem; for, if expense be no object, the efficient drainage of any moss is possible: as an economical proposition it is far otherwise. On this count, therefore, stone drains were out of the question, as a long haulage would have been necessary: pipe drains were equally inadmissible for reasons of cost, to say nothing of their unsuitability for deep peat. The only solution was to utilise the peat itself, and I accordingly adopted the method that I have employed elsewhere. Having decided to make the drains 3 ft. wide and at regular intervals of 15 ft., I had the ground marked out (by spade and line) in "strips" 3 ft. wide, at 15 ft. intervals, running the full length of the land to be drained, from the leader up to the highest point. The top divot at the highest end of the first strip was then scooped off by spades, care being taken to lift off the divot intact, and to keep the divot roughly to

the following dimensions:—3 ft. long (*i.e.* the width of the drain), 1 ft. broad and 1 ft. in depth, the latter being very important in order to ensure strength. The divot was then reversed, and put on one side of the drain to dry, and this process was repeated all the way down the drain, the divots, when lifted out, all lying packed together on one side of the drain and at right angles to it, with the grass side downwards. Peat spades were then employed, and two depths of peat were cut out of the drain in the usual way, being thrown on the 15 ft. bank to dry for fuel: by this time the drain was about $2\frac{1}{2}$ ft. deep. Next a narrow channel 5 inches wide (in this case the width of two peats taken edgewise) and 6 inches deep was cut out of the centre of the bottom of the drain, and the completed drain was left to dry till August, the work being transferred to the next drain: this was continued till the first week in July, after which it was too late to cut peats for fuel. By this time the drains that were first cut were already beginning to harden slightly on the inside, through exposure to sun and air, and by August some parts were hard enough to enable a man to stand on the “ledges”, at the bottom of the drains without breaking them down. My object was to obtain ledges (or shoulders) firm enough to bear the weight of a cover (and subsequently soil on top of the cover as well), and where the original moss was comparatively dry, the inside of the drains had, by August, a shiny crust on the surface similar to that of half-dried peats. In other places where the moss was literally an almost bottomless swamp, even three months’ exposure failed to harden the inside of the drains appreciably, and this difficulty had to be met by slightly different treatment when the time came to put on the covers.

At the beginning of August operations were again resumed on the first of the drains. The divots, which had by this time become very hard and compact, were replaced (grass side downwards) across the inside of the drains, the ends resting on the ledges formed at either side by the narrow channel cut out of the bottom. Each divot was then pressed firmly against its neighbour and tested for strength by being stood upon. Thus a cover was formed which rested firmly on sun-dried ledges of peat with a rectangular channel 5 inches wide and 6 inches deep below it, the total structure being capable of standing a man’s weight on it without either squashing the ledges or breaking the back of the divot in the centre. When places were met in the drains where (as mentioned above) the ledges had failed to dry and were in consequence certain to fall in sooner or later under the weight of the divots, dry peats were taken from the banks and placed flat on the ledges at either side, thereby ensuring a firm top to the ledge, which then withstood the weight of the divot without being squeezed or collapsing towards the centre of the drains, as the soft ledges alone would certainly have done. The whole area was completed by the middle of September, the peats being carted away for sale in Stornoway.

This completed the first part of the process: by this time beneficial results were already noticeable: the ground had subsided, all surface water had disappeared, the land was firm enough to stand upon without sinking, and all the “bog-cotton” had died

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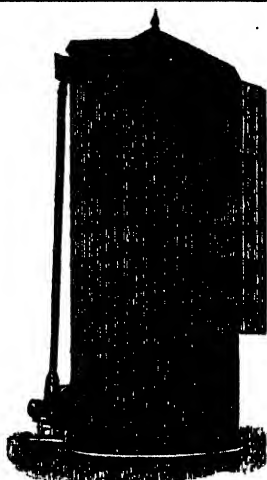
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away on the drained portion of the moor, whereas it was flourishing a few yards away on the undrained moor. The next step was to break up the surface in order to let in air and to pulverise it, but it was too late in the season to risk taking horses on to the land, and spade work on any scale was impossible on grounds of expense. At Gress (nine miles north of Stornoway), on a shallower piece of moor with a much steeper fall in the ground, a plough with a pair of horses was tried in the autumn with very satisfactory results, two acres being ploughed. Wooden squares were clamped to the horses' hind hooves to prevent bogging, and the horses were harnessed tandem to prevent one of the pair stepping in the soft furrow. At Arnish it was impossible to take the second stage further than to turn up a very small plot with the spade, cover it with a light coat of black peat-mould from the banks of the leader, dress partly with basic slag and partly with superphosphate and sow one half with a mixture of rye and winter vetches, the other half with a mixture of rape and rye. At the time of writing the rye is very healthy and of a good colour, the vetches are moderately good, and the rape (as might be expected) has been a failure. They have been exposed to every wind without the slightest protection (including the gale of 15th November), and although frosts have not been severe this winter, it must be remembered that the least frost is intensified on wet peat, so that it is quite an open question whether the rye and vetches will survive the remainder of the winter. But it must be made clear that this little plot was sown more for curiosity than anything else, and that far more thorough cultivation and manuring would take place prior to sowing in the ordinary course of events. As these processes are only now being taken in hand, it is beyond the scope of this article to deal with them.

Two questions will at once be asked. First, are these drains permanent? I hesitate to dogmatise, but provided that the ledges are well dried before the divots are replaced, and provided that the divots are carefully cut and carefully packed back into the drain, I see no reason why they should close in: I know of drains made with peat ledges and covers that are draining as efficiently to-day as when they were first made over twenty years ago. As is well known, a piece of dried peat does not revert to its original texture nor crumble away, even when buried in deep wet soil: it is a common experience to find small pieces of peat retaining their original shape and hardness when one is digging in soil with which the refuse of peat stacks, etc., has been incorporated at one time or another. Provided, therefore, that the ledges in the drains are allowed to dry thoroughly before the divots are replaced (which can be done by cutting early and covering late in the summer), there is no reason to assume, so far as I can see, that the drains should ever revert to "slurry" or close in gradually.

The second question is—How are the drains filled in on top of the divots? This difficulty is more apparent than real. The furrow slice nearest the drain on either side is turned sharply over by the plough so that it falls into the drain, and the resultant depression, though marked for the first year, is no great hindrance to cultivation: in the second year the surface, through harrowing,

somewhat resembles the old "saddleback" layout of land, and the undulation can be eliminated altogether in the third year. In practice, I have never found these drains to interfere much with tillage.

The advantages of this system of drainage are, I hope, obvious, but I must add the warning that three essentials are necessary for economy in working: (1) a ready sale for the peats; (2) short haulage for the peats; and (3) a reasonable rate of wages. On Arnish these essentials were not present: the peats did not sell readily owing to their inferior quality, the moor being comparatively "new" and therefore very spongy, the cost of carting was enormous and the rate of wages very high. But given a fairly dry moor, a moderate wage-rate, and an adjacent market, I still see no cause to alter my opinion that the cutting of peats in this way should cost only very little more than cutting them on the ordinary peat hag, with the additional great benefit that the ground is being thoroughly drained by the same operation.

A GOOD deal has been written in recent years with reference to the occurrence of smut in grain and more particularly as to the

**Smut in Wheat and
other Grain.**

use of formaldehyde as a fungicide. The usual recommendation has been to dip or spray the seed for about ten minutes with a solution consisting of one part of commercial formaldehyde solution to 320 parts of water, followed by a ten minutes' drain. The question of the effect of such treatment on the seed has not hitherto been the subject of any very extensive or exhaustive experiments, but many publications dealing with seed treatment contained warnings against the storage of formaldehyde-treated seed that had not been thoroughly dried after treatment. Some writers also advised that the seed should be sown immediately after treatment and not stored, thus showing that it had been learned from experience that the injury to the grain occurs not so much from the treatment as from holding it in store afterwards.

The *Journal of Agricultural Research*¹ for November last contains an article describing the results of an investigation of the post-treatment action of formaldehyde on seeds. The investigation was begun in 1918 in the plant pathology laboratories of the University of California as a part of the cereal-smut eradication campaign carried on by the United States Department of Agriculture, and was continued for a period of nine months. The experiments covered a wide field and were carried out in varying conditions with a view to arriving at the exact cause of injury to treated seed, and so determining methods which would leave the germinating properties of the seed unaffected. The report includes several tables which give in statistical form the results obtained. Table I. gives the percentage of germination of wheat treated with 0.1 per cent. formaldehyde solution and stored, either damp or dry, in various temperatures and for various periods. Tables III. and IV. show the results of seed being sown in dry soil immediately after treatment and remaining there for some time before sufficient

¹ Published by the United States Department of Agriculture, Washington.

rain fell to dampen the soil and induce germination. Other tables show the percentage of germination of seeds which had been treated and subsequently dried under different conditions and stored for varying periods of time, etc.

It is not possible, within the limits of these notes, to give anything approaching full details of the experiments, but the major conclusion reached is that it is extremely hazardous to dry seed that has been treated with formaldehyde solution and also that, contrary to common belief, seed wheat is absolutely uninjured by a 0.1 per cent. solution (1 to 40) and, if kept moist, may be held indefinitely without injury, unless attacked by moulds. No seed injury was produced if wheat thus treated was germinated immediately after treatment, but if treated seed was held several days or more before sowing, it was severely injured if allowed to dry without thorough aeration during the storage period. The post-treatment injury was found to be minimised by spreading the seed as it dried so that maximum aeration occurred.

Post-treatment injury is usually cumulative, increasing in degree the longer the seed is stored, and the writer suggests that the injury on drying is due to a deposit of paraformaldehyde on the seed which forms as the formaldehyde evaporates. The degree of post-treatment injury depends primarily on atmospheric humidity during the storage period. In atmospheres damper than 70 per cent. humidity, the treated seed can be kept indefinitely without ill effects. In those of 70 per cent. and less there is decided injury which is most severe in the intermediate humidities until seed stored in an absolutely dry chamber is almost uninjured.

The data in Table III., already referred to, indicate that it is not safe to treat wheat with formaldehyde, even when the strength of solution is as weak as 0.1 per cent. if the wheat must be sown in very dry soil without certainty of rain within a few days. Besides a lower percentage of germination, the germination of the injured seed lots was retarded, often by several days, and they produced a considerable number of spindling or short plants which apparently would never be strong. Field reports have also been found to be in agreement with those laboratory tests. Seed dried for an hour by being thinly spread on towels in the laboratory and then sealed in bottles was uninjured after weeks of storage, but seed dried longer, although uninjured by the rapid drying, was injured upon being sealed, presumably because of the concentration of gas in the bottle as a result of decomposition of the paraformaldehyde on the seed.

Barley was found to be less susceptible to injury upon drying after soaking in a 0.1 per cent. solution, probably because of the protection afforded by the glumes; but when stronger solutions were used the injury was very severe.

The writer concludes by stating that post-treatment injury from dry storage is entirely prevented by washing the seed with water immediately after treatment.

THE following discussion of the causes of sheep panic is extracted from a recent issue of *Nature*:—

A sheep panic on the night of December 10-11, in which the sheep broke their folds in twenty parishes in an area extending some twenty miles in the highest part of

Sheep Panics.

Cambridgeshire, has been attracting attention. These panics have often occurred, for sheep are notoriously timid and nervous animals. On November 3, 1888—an intensely dark night, with occasional flashes of lightning—tens of thousands of folded sheep jumped the hurdles and were found scattered the next morning. Every large farm from Wallingford to Twyford was affected, and those on the hill country north of the Thames most so. Again, on the night of December 4, 1893, another very remarkable panic among sheep occurred in the northern and middle parts of Oxfordshire, extending into adjoining parts of the counties of Warwick, Gloucester, and Berks.

Various causes for these panics have been suggested, but only one reasonable explanation has been satisfactorily adduced. The 1893 panic was, at the time, fully investigated by Mr O. V. Aplin, who published in the *Journal of the Royal Agricultural Society* the result of his inquiries, and the conclusions he drew from the extensive evidence collected. The conclusion arrived at was that the cause of the panic was simply thick darkness. Very few people, probably, have ever been out in a really dark night, and it is impossible for anyone who has not had this experience to imagine what it is like and the sense of helplessness it causes. That a thick darkness of this kind was experienced in the early part of the night of the recent panic (at a time agreeing with that at which, so far as was known, the sheep stampeded), was proved by abundant evidence. One report said that it was between 8 and 9 P.M. when such a thick and heavy darkness came on that a man could not see his own hand. Another witness wrote that a little before 8 o'clock there was an extraordinary black cloud travelling from north-west to south-east, which appeared to be rolling along the ground. The darkness lasted for thirty or forty minutes, and during that time it was like being shut up in a dark room. Later in the night—long after the panics—there were several flashes of lightning.

Mr Aplin states that animals probably see perfectly well on ordinary dark nights, and we can imagine a bewilderment coming over them when they find themselves overtaken by a thick darkness in which they can see nothing. Folded sheep (and it was the small folds that the sheep broke most) in moving about would knock against their feeding-troughs and one another, and the first one that got a fright from this and made a little rush would probably come into collision with one or two others, and it would need nothing more to imbue the whole pen with the idea that there was some cause for fear. Then they would all make a rush, and their terror and the momentarily recurring incentives to, and aggravations of, it in the shape of collisions would only subside when the sheep had broken out and were in the open, clear of one another and of their troughs and hurdles.

If this is the explanation of the panic, then it is easy to understand why folded sheep are so much more likely to suffer than those lying in open fields. The heavy, oppressive atmosphere

accompanying the thick darkness, the susceptibility of sheep to atmospheric disturbance, and their nervous and timid dispositions would all tend to increase the fright the sheep experienced. The cause of the panic being a cloud rolling along so low down as (apparently) to touch the ground, the tops of the hills and the high-lying ground would naturally be most affected; and this is observed to be the case, although locally the usual direction followed by thunderstorms has indicated a line along which sheep stampeded on nearly every farm.

THE following note of the information made available by the Meteorological Office as to future weather conditions should be of interest to farmers.

This office issues telegraphic notifications of occasions on which a spell of fair, settled weather of several days' duration is expected. Recipients of such notifications will be kept informed during the continuance of the spell of the progress of meteorological events, and warning of the break-up of the spell will be sent as far in advance as possible. A fee of sixpence is charged for each telegram dispatched, in addition to the Post Office charges for telegraphy. A minimum sum of 7s. 6d., against which the charges may be booked, must be deposited with the Meteorological Office.

Daily forecasts are also issued from 1st May to 30th September, containing a statement of the weather prospects drawn up at 4 P.M. summer time each week-day for the use of farmers and others. Daily forecasts for single districts can be sent by telegraph for periods of not less than six consecutive days to any address in the United Kingdom upon pre-payment of a registration fee of one shilling and the cost of telegraphy, computed at one shilling per message.

The office will also send by telegraph forecasts in anticipation of special conditions, such as spells of frost, ground frost, etc. If the time of sending the forecast be left to the discretion of the Meteorological Office, a fee of 2s. 6d., which includes the cost of the telegram, is charged for this service.

Forms of application may be obtained from the Director, Meteorological Office, Air Ministry, Kingsway, London, W.C.2.

IN view of the great changes that have taken place during and since the war in the wages and conditions of labour on farms in Scotland, it was considered desirable in connection with the administration of Part II. of the Corn Production Act, 1917, and for future reference to obtain as complete and up-to-date information on the subject as possible.

A Report¹ was accordingly prepared by Sir James Wilson, K.C.S.I., Chairman of the Central Agricultural Wages Committee

¹ Report to the Board of Agriculture for Scotland on Farm-Workers in Scotland in 1919-20. To be purchased through any bookseller, or direct from H.M. Stationery Office, Forth Street, Edinburgh. Price 7s. net, with postage 7s. 2d.

for Scotland. The figures are based on a comparatively small number of schedules received from selected farmers in various parts of the country; the number of returns received covers about 4 per cent. of the number of holdings above fifty acres and also about 4 per cent. of the total number of persons returned as wage-earning farm workers in the Census of 1911.

The Report deals with all classes of agricultural labour and the returns given show for each permanently employed farm worker his or her age, cash wages and allowances in kind. The cash value of the allowances in kind is calculated at the value placed upon them by the District Wages Committee for the purpose of the minimum wage, and is added to the cash wages in order to estimate the total average weekly earnings of each worker. The permanent male workers are classified as follows:—(1) shepherds, grieves or foremen; (2) ploughmen; (3) cattlemen; (4) shepherds; (5) orramen, the last class including all male workers who are not in special charge of animals.

It is not claimed that the calculations, based as they are on so small a proportion of the total number, are absolutely accurate for the whole, but as they corroborate each other they can be accepted as approximately true results. In any event the figures given can be said to afford the best available basis on which to form an idea of the average earnings of farm workers in Scotland during the winter half-year 1919-1920.

A new feature of the agricultural labour problem in Scotland is the system under which voluntary local agreements are made between the National Farmers Union of Scotland and the Scottish Farm Servants Union as regards working hours and other conditions, and these agreements are very fully detailed in Part II. of the Report.

Ploughmen are perhaps more particularly than any other class dealt with in the Report and in Part III. will be found a table giving, by counties, the average earnings of a married ploughman in the summer of 1920. Part IV. of the Report summarises the provision of Part II. of the Corn Production Act, 1917, and gives an account of the work of the Wages Committees set up under the provisions of the Act.

Appendices are attached containing tables as to the numbers and ages of farm workers, the average cash wages and the average value of allowances paid to all classes of workers between the ages of twenty-one and sixty in the various counties in Scotland.

IN answer to a recent Parliamentary question, the Ministry of Agriculture and the Ministry of Food stated that the scheme for carrying out the promise made by the Prime Minister to the National Farmers Union on the 16th February last, with regard to home-grown wheat prices, has been completed by the Ministry of Food, and will come into operation on and from the 7th March instant.

Under the scheme, millers are instructed to pay for home-grown wheat of sound milling quality—*i.e.* of fair average quality for the season, fit for milling into flour for human consumption,

95s. per 504 lbs. if bought free on rail, or 96s. per 504 lbs. if delivered into the mill by road. Proportionately lower prices are to be paid for wheat of inferior quality or condition.

The price of 95s. per 504 lbs. for home-grown wheat of sound milling quality will continue so long as the average c.i.f. cost of imported wheat remains above the parity of that figure. This average will be the average of the c.i.f. cost of all milling wheat imported during the two preceding months, together with the actual and anticipated arrivals in the United Kingdom during the current month, subject to adjustment in respect of the lower percentage of flour of equal water content obtainable from home-grown wheat as compared with imported wheat. In the event of this average falling below the equivalent of 95s., the price of home-grown wheat will be adjusted accordingly, and the revised price to be paid by millers will be announced monthly. The above arrangement will come to an end on 13th August 1921.

With regard to purchases between the 8th November 1920 and the 5th March 1921, farmers or merchants who sold home-grown wheat to millers financially controlled by the Flour Mills Control Committee will be paid the difference (per 504 lbs. of wheat delivered) between the price paid by millers and 95s. free on rail or 96s. delivered into the mill by road. In respect of each purchase of home-grown wheat of inferior quality or condition payment will be made of the difference between the price actually paid and the value of the wheat compared with wheat of sound milling quality (namely, 95s. f.o.r. or 96s. delivered into the mill). Claim forms will be obtainable from (a) any miller; (b) the Incorporated National Association of British and Irish Millers Ltd., 40 Trinity Square, E.C.3; (c) the National Farmers' Union, 45 Bedford Square, W.C.1; (d) the Board of Agriculture for Scotland, Edinburgh; (e) the National Farmers Union for Scotland, 113 St Vincent Street, Glasgow; (f) the Department of Agriculture and Technical Instruction for Ireland, 60 and 61 Upper Mount Street, Dublin.

The claim form, when filled in by the seller, must be submitted to the miller to whom he sold the wheat, and the miller will verify the claim by reference to his books, and having agreed the amount with the claimant, will sign the certificate printed on the claim form and return it to the seller.

The seller will transmit the certified claim to the Statistical Branch, Flour Mills Control Committee, 100 Cromwell Road, S.W.7, and the claimant will receive in due course a payable order cheque, the cashing of which provides in itself the necessary receipt.

It will be seen that the above arrangement provides for repayment being made in respect of all wheat which was sold to controlled millers for milling into flour by either farmers or merchants. In those cases in which farmers sold their wheat to merchants or dealers, the farmer must make application to the merchant or dealer to whom he sold his wheat.

The Ministries desire to emphasise the fact that the National Farmers Union has agreed that payments to persons, whether farmers or merchants, who have sold home-grown wheat to millers, will be regarded as a complete fulfilment of the Prime Minister's

pledge, as regards transactions between 8th November 1920 and 5th March 1921, and consequently, so far as dealers are concerned, it is a matter of honour and good faith that sums due to farmers under this scheme shall in due course be passed on by dealers to the actual producers of the wheat. The National Farmers Union hopes that the moral obligation thus resting upon dealers will be recognised in a spirit of friendliness and good will.

It should also be noted that the Prime Minister made it clear that the promise applies only to wheat which has been or may be sold by a farmer, direct or through a merchant, to a miller for milling into flour for human consumption.

As the mills cannot absorb wheat in excess of the quantity required to meet the current demand for flour, the Prime Minister also pointed out that it is impossible to guarantee a market for all the wheat that may be offered at any particular time. The whole of the home-grown wheat still to be marketed will, however, be required by millers during the remainder of the cereal year, and will be readily absorbed, provided it is marketed in normal quantities.

THE Handbook and Report for 1920 shows that very material progress has been achieved by the Institutes during last year.

**Scottish Women's
Rural Institutes.**

This is demonstrated both by increasing numbers (at the present date 165 Institutes as compared with 100 at the end of December 1919), and by a noticeable development of interest in agricultural affairs and home economics. The latter must be attributed in part to the reversion to peace conditions, but the steady growth in membership of the older Institutes and their increasing demand for educational facilities tend to suggest that the evidence given to the Agricultural Policy Sub-Committee (Cd. 9079) may be said to hold good for Scotland. "The experience of Canada is very suggestive. There, as we were informed, the Women's Institutes have made the whole difference to agricultural and domestic education. When the instructor comes to a village where there is a Women's Institute, he is no longer met with coolness or indifference, but finds a receptive audience and an organisation which carries on his work after he has gone away. The Women's Institutes are regarded as an essential link between the instrument and the objects of rural economic instruction and between the different Departments of Government and the country folk."

Reports submitted by local Honorary Secretaries cannot be read as representing the whole volume of work accomplished, but they show that in interests relating to household management 620 lectures and demonstrations have been given, and in agricultural interests attached to the home—*e.g.* dairying, poultry work, gardening—the number is 165. In community work 180 lectures have been given, and in general subjects 211. Regular classes have been held in basket-making, cookery, cutting out, dressmaking, fur craft, millinery and sewing. Open lectures by members of the Colleges of Agriculture staffs have been arranged for.

From the returns submitted by the Institutes it is noticeable that the greater number have increased their membership, and that in every area the percentage of attendance at meetings is higher than last year.

The Central Area Committee are making arrangements for an exhibit in connection with the Highland and Agricultural Society's Show on the lines of those held in the past two years. Such exhibits are of value not only in bringing Institute work to the notice of the general public, but in encouraging a good standard of work in the Institutes, and that corporate feeling which enables all members to work together for a prize instead of as individuals.

Area study meetings, at which Institute work in its broader aspects will be discussed and demonstrations and advice given in practical subjects, are to be held in Aberdeen, Fort William and Edinburgh this summer. This will probably mark the most distinct step taken in the Institute movement in Scotland up to the present time.

THE weather during December, January and February was on the whole more mild and open than usual. Some snow fell towards the end of January, but, speaking generally, there has been throughout the winter a marked absence of snow and frost.

Agricultural Conditions.

In January the rainfall was above the average, and high winds were prevalent, but February was particularly mild and dry, the rainfall being the lowest for a considerable number of years. As a result of the favourable weather, field work has proceeded with very little interruption, and cultivation is in most cases well advanced.

The mild weather conditions have been exceptionally favourable for the wheat crop, and the present prospects are very promising. The plant is generally stated to be healthy and vigorous, and in many districts it is unusually well forward in growth. The area sown this year is not estimated to show, on the whole, any considerable variation as compared with last year.

During February a beginning was made with the sowing of oats in Kincardine and North-East Forfar, while in South Ayr early potatoes were planted under favourable conditions, and considerably earlier than in normal years.

The condition of last season's potato crop is generally reported to be fair. Some damage has been caused by sprouting in the pits, especially in the north-eastern and eastern counties, and in these counties there are also more signs of disease than in other parts of the country. From several districts it is reported that some of the newer varieties are not keeping well, amongst these being mentioned especially "Arran Comrade," "Great Scot" and "King Edward." In Kincardine, it is stated that "Arran Chief" is keeping better than most of the other varieties.

Ewes are generally reported to be in good condition, and the reports received at the end of February were almost unanimously to the effect that the lambing prospects were exceptionally favourable. Lambing was in progress on arable farms in Rox-

burgh, Selkirk and Fife at the beginning of March, but elsewhere regular lambing had not begun at that date. Turnips are plentiful except in some of the western and south-western counties. Keep is sufficient generally in the majority of the districts, but in South-West Forfar, Central Perth and Orkney straw is stated to be scarce. Feeding cattle have wintered well, and all classes of live stock are generally reported to be in good condition.

The supply of labour is now adequate for present requirements in most cases, and in Moray and Central Aberdeen some men are said to be unemployed. Casual labour is deficient in a few districts, while in Renfrew dairy workers are difficult to secure, and in Dumfries experienced ploughmen and cattlemen are short of requirements.

RECENT PERIODICAL LITERATURE.

The following extracts and summaries are taken from recent bulletins of the International Institute of Agriculture. Full references to the bulletins, and to the original publications quoted therein, may be obtained on application to the Secretary, Board of Agriculture for Scotland, 29 St Andrew Square, Edinburgh.

The Pre-Determinant Influence of the Physiological Condition of the Seed upon the Course of Subsequent Growth and Yield of the Plant. *F. Kidd and C. West, Annals of Applied Biology.*—I. After having studied the effect of soaking seeds in water, and the influence exerted by the parent plant upon the course of the subsequent growth and yield of the offspring,¹ the authors continue their study of the predeterminant influence of the seed upon the plant.

In the article summarised, they treat of the effect which the greater, or less, maturity of the seed at the time of harvesting exerts upon its germinative energy or potentiality. A very complete review is given of the publications dealing with the subject, and of the different results obtained by other investigators. A consideration of these data makes it clear that the question as to whether differences in the resulting plant are pre-determined by the use of seeds differing in degrees of ripeness cannot be regarded as satisfactorily answered in the case of any single species. This is due to the fact that all the recorded comparisons between plants grown from immature seeds, and plants grown from mature seeds, appear to have been complicated by some period of storage. Immature seeds are less tolerant of storage in the dry condition than mature seeds, so that in the case of the comparisons that have been made, the total yields from immature seeds are usually less than those from mature seeds, owing to the fact that a smaller percentage of the former germinate. When, in such experiments, comparisons are made between yield per plant, however, the difference in favour of the plants from mature seeds tends to disappear, or even to be reversed. This result may be significant, but it must be remembered that while the yield per plant in the case of the mature seeds represents an average based on the total number (which includes both vigorous and weak plants), the yield per plant, in the case of the immature seeds, on the other hand, probably represents an average based on the more vigorous individuals only, the others having perished during storage in the seed stage.

From the practical point of view, seed harvested at a stage somewhat previous to maturity may, under certain conditions, give a better yield than seed allowed to become dead-ripe upon the parent plant, but seeing that immature seed does not withstand storage well, its use is not to be recommended.

II.—In this article, the writers treat of the effect of conditions during germination and in early seedling stage upon subsequent growth and final

¹ See extract in this *Journal*, Jan. 1920, p. 103.

yield. These conditions were modified artificially by: (1) the total, or partial, removal of the cotyledons, endosperm, etc.; (2) soaking the seeds in water, or impregnating them with nutrient salts; (3) inoculating the seeds with enzymes.

It may be stated that the conditions operating during germination and the early life-cycle of the plant are of the utmost importance, especially in the case of annuals and biennials—i.e. in the case of the majority of economic crops. These conditions exercise a pre-determining influence upon subsequent growth, and directly affect the yield. In many cases, the value of the effects obtained is, from the economic point of view, out of all proportion to the cost of the treatments used.

It is recognised that some sort of correlation exists between the vigour of the seedling and that of the adult plant, but this vigour may be due either to hereditary or to environmental factors that have operated previous to, or during, germination and which, as we have seen, greatly affect the subsequent development of the plant. It is therefore necessary to determine, by the help of experimental work, whether a law can be propounded to the effect that increased vigour of seedling development due to environmental conditions as distinct from hereditary causes is correlated with increased vigour of growth throughout the life of the plant.

The Occurrence of Dwarf Plants and the Transmission of that Character in Pure Lines of Victory (Seger) Oats, in the United States. C. W. Warburton, *Jour. of Amer. Soc. of Agronomy*.—In 1916, at the Aberdeen Station (Idaho), the author noticed, in a row of 20 plants of Victory (=Seger of Svalöf) oats, the occurrence of 8 quite abnormal specimens. The plants tillered abundantly, so that low tufts were formed with rather stiff erect leaves at the base; the culms, few in number, are less than 10 inches in height and bear generally a very small inflorescence with 3 or 4 spikelets; these dwarf plants are very late and frequently their seed is not ripe before the first frosts. In 1917, the author sowed a few matured seeds and obtained progeny all of which were dwarf. In the original row of dwarf plants there were 12 normal (tall) plants; 40 seeds were taken from each of 10 of these plants and sown in 10 separate rows. In 1917, the resulting plants were examined and it was found that 4 of the plants had produced normal plants exclusively, while the other 6 had a mixed progeny of tall plants (168) and dwarf plants (66), in the ratio 2.55:1, which corresponds fairly well with the Mendelian ratio 3:1 observed in F_2 of the hybrids with 2 allelomorphs, one of which is dominant. In this case the "normal" character would be dominant.

Successive generations would then be constituted by homozygous plants (dwarfs and normal) which remain constant, and by heterozygous plants (normal in appearance owing to dominance) which would divide in the following generation into dwarf and normal plants.

Subsequent research undertaken at other Stations (Ithaca and St Paul) confirms the results obtained at Aberdeen. However, the author cannot fix the causes or cause of the sudden appearance of abnormal plants in Victory oats.

The Calvino Method of Increasing Leaf Development in Some Kitchen Garden Plants. A. L. Reyes, *Havana*.—Prof Mario Calvino, the Director of the Agricultural Station at Santiago de la Vegas, Cuba, advises as a practical method to be adopted in intensive kitchen-gardening the perforation of the primary root in a horizontal direction. In this manner, greater foliar development is obtained in plants which, like chicory, lettuce, parsley, etc., are grown for the sake of their leaves. The writer tried this method upon parsley at the above-mentioned Station. The plants used for the experiment attained a diameter of 80 cm., and a height of 40 cm., the measurements of the control individuals being respectively 55 and 30 cm.

Intra-organic Injections for the Purpose of Increasing the Yield of Plants: Experiments in Mexico and Cuba. M. Calvino, *Havana*.—Although the Russian botanists were the first to study the effect of injections upon plants, the credit of applying this treatment to a definite agricultural purpose belongs to Prof. Petit, of Paris. When the writer was Director of

the Central Agricultural Station of Mexico, he carried out, in 1912, a series of experiments with a view to determining the practical value of these injections. An old pear-tree, which was covered with blossom every year but never bore fruit, was subjected to the following treatment:—At a little distance above the level of the ground, a hole extending as far as the fibro-vascular bundles was bored in the trunk. Into this hole was inserted a small glass tube communicating by means of rubber-tubing with a vessel (placed 1·5 m. above the ground) containing a nutrient solution composed of: water 18 litres + sulphate of iron 19 gm. + nitrate of sodium 10 gm. The tree absorbed the solution in about 3 days. The following month, the leaves were larger and brighter in colour than those of the control trees (two old pear-trees which, like the first one, flowered freely, but produced no fruit), numerous fruits set and developed well, whereas the control trees bore no pears.

In 1913, the writer made another experiment on a sterile pear-tree. He used the following solution:—water 20 litres + superphosphate 5 gm. + sulphate of potassium 5 gm. + nitrate of sodium 5 gm. + sulphate of iron 5 gm. The pear-tree absorbed more than 50 litres of this solution just before the moment of flowering. It was well covered with blossom and bore fruit. A lilac grafted on a privet was treated in the same manner, and produced a larger number of finer flowers.

The writer continued his work at the Agricultural Station of Santiago de las Vegas, where he experimented upon caryas.

This operation method opens up new fields of work:—the injection of virus into plants suffering from bacterial diseases; the injection of vegetable substances (camphor, etc.) to induce vigorous growth; the injection of a solution of the product for which the plant is cultivated (for instance sugar in the case of the sugar-cane), in order to induce the "habit of the substance," and thus obtain more productive varieties etc.

Method of Growing Potatoes in Winter. *C. Hugues, Milan*—During the winter of 1903 the author found out that new potatoes came on the market of Gorizia at the period of most intense cold. He found they came from Germany, where late planting in the very cold spring of 1902 did not allow the potatoes to mature before winter, so that a large part of the crop was left in the field during the winter.

What happened there through force of circumstances was followed soon afterwards by the experiments carried out by M. Schribaux in France. These showed that certain varieties of potato, such as *Magnum Bonum*, if planted at the end of July and overtaken by frost when in full growth, may be left in the ground all winter. They must be protected from frost by a mulch of earth and manure, and may be lifted as they are required for sale as new potatoes in winter or spring.

Other trials made later in Brittany showed that to prevent these potatoes freezing in the ground an ordinary moulding up along the drills is sufficient. At Paris, with a winter temperature as low as -10°C , a layer of earth 20 cm. deep is all that is necessary; in other places with a temperature, as low as -14°C , a layer 25 cm. deep was sufficient.

The Effect of Organic Matter on Soil Reaction. *R. E. Stephenson, Soil Science*.—The object of this work was to study the effect of decomposing organic matter upon the production of acids or bases in the soil. Very little has hitherto been done in this direction, hence the special importance of the present investigations. Pots containing two soils were used in these experiments, one a dark soil fairly rich in organic matter, the other a sandy loam poor in organic matter. To these soils were added albumin, casein, starch, dextrose, lucerne and ammonium sulphate. In one series of pots the soil was limed, in the other it was not. Optimum moisture conditions were provided as nearly as possible by daily watering, but no plants were grown in the pots.

Results.—None of the organic substances added increased the lime requirements of the soil; the highly nitrogenous materials had rather the effect of decreasing the acidity. The carbohydrate materials had a small and inconstant effect upon the soil reaction, whereas ammonium sulphate consistently caused a marked increase in the lime requirement of both soils.

The nitrogenous organic materials, which tended to protect the carbonates of the soil at first, later on used up the limestone. Ammonification was greater in the unlimed pots of both series; the sandy loams were acid soils. A difference in the soil flora may possibly explain this increased ammonification. Both the casein and blood ammonified more rapidly than the dried blood. Ammonia did not accumulate in the presence of either carbohydrates or lucerne.

Finally, in the presence of carbohydrates and of lucerne, no nitrates were found until the end of the 15th week; this was probably due to their having been consumed by the organisms of the soil.

The two soils used in the experiment showed marked differences in their behaviour under the different treatments. The more acid soil was the more active, probably because of a greater content of organic matter and a more abundant microbic flora. This shows that measurable acidity is not an index of toxicity. The permanent effects of acidity are attributable solely to the liberation of mineral acids, but the basicity resulting from the breaking down of protein is of a more lasting character than any acidity that may result. This is due to the fact that the organic acids are either volatile or are oxidised to carbon dioxide which is volatile, whereas nitrogenous bases are continuously active, and are held by the soil until they are nitrified.

Conclusion.—It may be stated that, in general, the organic matter in the soil seems to act the part of a base rather than that of an acid, at least to the extent that a given acidity is less detrimental in the presence of an adequate supply of organic materials.

The Action of Fluorides on Plants. *A. Gautier and P. Clausmann, Comptes Rendus de l'Académie des Sciences.*—The preliminary cultural experiments made by the writer in pots, and on entirely artificial media with or without the addition of fluorine, did not sufficiently show the effect of fluorine upon plant growth. He therefore resolved to make some field experiments

The soil of the field selected for this purpose was sandy clay, with scarcely any lime and containing in its natural condition 88 mgm. of fluorine per kg.; to all the lots treated with fluoride, 55.8 mgm. of amorphous calcium fluoride was applied per sq. m. to a depth of 0.25 m., which corresponds to 100 mgm. of fluorine per kg. of soil. The field had lain fallow for 2 years, and its surface had been divided into 18 pairs of equal plots, separated from each other by a space of 0.90 m. One plot in each pair was treated with fluoride and the other one was not. As the addition of calcium fluoride necessarily introduces a small quantity of lime, care was taken to add to each of the control plots, the equivalent amount of powdered chalk.

In their experiments, the writers used the most commonly grown plants: wheat, oats, carrot, potato, beet, haricot beans, cabbages, poppy, peas, barley, etc. Each of the plants was respectively grown in the plot to which the fluoride had been added, and in the control plot. The writers give the comparative (qualitative and quantitative) results obtained, which may be summarised as follows:—

Wheat: increase in total crop 13 per cent.; increase in grain yield 18 per cent.—*Oats*: increase in crop 12 per cent.; increase in grain yield 5.2 per cent.—*Carrots*: gain in plots with added fluoride 17.9 per cent.—*Potatoes*: slight superiority the first year, then in second year gain of 58.7 per cent.—*Beets*: deficit in plots with added fluoride—*Peas*: slight superiority of plots treated with fluoride: 5.7 per cent. more the first year, and 12.6 per cent. the second—*Haricot beans*: no difference—*Cabbages*: no difference in crop the first year; apparently the fluoride had not a good effect—*Poppy*: gain of 14 per cent. in the plot treated with fluoride.

Thus, other conditions being equal, the addition of fluorides, especially of amorphous powdered calcium fluoride, to arable soil has a beneficial effect upon wheat, oats, carrots, peas, poppies, and potatoes. The writer mentions that crystallised calcium fluoride, or natural fluophosphates are not equally efficacious. Rye, barley, buckwheat, haricot beans, and mustard are unaffected, or but little affected, by this fertiliser. Beet, turnips, and onions are injured by fluorides. All these plants were grown

in the open on poor soil to which no fertiliser had been added except 2000. gm. of amorphous calcium fluoride per kg. of soil.

Given the slight solubility of calcium fluoride, the amount could easily have been doubled, or trebled, and more decisive results might have thus been obtained. Perhaps plants with a higher fluorine content than usual could have been produced.

As fluorine always accompanies phosphorus in the tissues, being assimilated and eliminated with it, and as it seems to ensure the fixation of this element which itself has a great effect in stimulating the reproduction of tissues, a considerable increase in the vitality and fertility of agricultural crops is naturally to be expected from the combined use of fluorides and phosphates.

The Influence of Farmyard Manure on Clover. *E. J. Russell, Jour. of Min. of Agric.*—An enormous quantity of work has been carried out during the last 35 years in connection with the manuring of different plants, but, in spite of its great importance in the crop rotation, clover has been omitted, perhaps because of its liability to "sickness," which renders it unsuitable for a continuous series of experiments. The author carried out a series of field tests on this subject; he compared the residual value of ordinary farmyard manure and of farmyard manure from cake-fed cattle, of shoddy, rape cake, superphosphate, bone meal and basic slag, on clover following a wheat crop on land where clover had not been grown for over 14 years. The manures were applied 1, 2, 3 and 4 years before the clover.

None of the manures, except farmyard manure, had any appreciable effect on the clover; applied 2, 3 and even 4 years beforehand it produced notable increases in the yield of clover. It had, further, a distinct effect on the wheat crop grown after the clover, the heaviest crop of the latter having been followed by a heavier wheat crop. In conclusion it should be noted that the action of the farmyard manure only affected the first cut, the yield of the second cut being approximately the same with farmyard manure as with the other manures.

To sum up, farmyard manure has an important residual effect on clover which should be taken into account in estimating its influence on the crop rotation.

The Utilisation of the Energy of Waterfalls for the Manufacture of Nitrogenous Fertilisers. *Paul Lévy-Salvador and E. F. Cote, Paris.*—M. Lévy-Salvador recalls the fact that 1 kilowatt-year is sufficient to fix 450 kg. of nitrogen as cyanamide and only from 120 to 130 kg. as nitric acid (by the Birkeland and Eyde process).

In the manufacture of nitrates, which was studied by the war services, some new processes were used that are still kept secret, but could be used commercially. It would be a matter of interest to follow the application of another process besides the one carried out in the Birkeland and Eyde furnace, and giving a larger yield than this method.

M. Lévy-Salvador mentions that a factory cannot do with less than 10,000 kw., and makes the very suggestive remark that in order to make, by means of the Birkeland and Eyde process, improved by G. Claude (superoxygenation of the air), 200,000 tons of nitrate of lime, an amount far below the average quantity imported from Chile before the war, it would be necessary to have 140 factories each of 10,000 kw.

The net cost of a kilogramme of nitrogen, given the cost of hydro-electric energy in France, is still too high for it to be possible for artificial nitrates to compete with Chile nitrates.

M. E. F. Cote gives in the same number of *La Houille Blanche* a series of figures which are of interest in this connection.

At the end of 1918, 200,000 h.p. of "white coal" will be used in the manufacture of calcium carbide and cyanamide, nitrate of lime and nitric acid. This energy represents an annual production of 100,000 tons of cyanamide.

In 1913, only 8000 tons were made in France, and 30,000 were made in Germany, which country will raise its output this year to 400,000 tons.

On the other hand, the Haber process, which has been carried to great perfection in Germany, has probably produced 500,000 tons of ammonium sulphate in 1918, instead of 30,000 tons, as in 1913. In 1913, France used

only 30,000 tons of Chilian nitrate—that is to say, 7 to 8 kg. per hectare, as against 15 and 18 used respectively by England and Germany.

Before the war, Germany used to take annually 300,000 tons of nitrate of sodium.

Antiseptic Action of Spices in Preserved Foods. *Jean Labache, L'Industrie française de la Conserve.*—The author gives an account of investigations on the antiseptic action of spices in preserved foods. All this subject is, so to speak, in its infancy, and will be continued. But already attention should be drawn to the preliminary results obtained, which establish absolutely the antiseptic action of certain spices. The spices most generally used are black pepper, Cayenne pepper, ginger, mustard, cinnamon and cloves. The first three, in the experiments, prevented fermentation and putrefaction only for a very short time. But mustard, cinnamon and cloves (whose antiseptic principles are their essential oils) are much more effective. They are powerful antiseptics, even in the small quantities in which they are used in food industries. Anyhow, these spices have an antiseptic action decidedly greater than that of the usual chemical antiseptics of which, moreover, the use is expressly prohibited by French law, while that of spices is legally permissible and is in no way contrary to hygiene.

The Household Foam Test for Butter and Oleomargarine. *H. H. Sommer, Jour. of Dairy Science, Baltimore.*—One of the household tests for distinguishing between butter and oleomargarine and renovated butter is the "foam test." Butter when heated boils quietly with an abundant production of foam, whereas oleomargarine and renovated butter sputter and do not produce so much foam. The author investigated the cause of this difference, which is the subject of this article, and he came to the following conclusions:—

- (1) Fats will foam if the water that they contain is held finely divided in suspension; they sputter if the water gathers in droplets.
- (2) The curd in butter is finely divided and holds small particles of water in suspension; therefore butter foams.
- (3) The curd in oleomargarine and renovated butter is coarse and allows the water to gather in droplets; therefore oleomargarine and renovated butter sputter.
- (4) Certain "butter substitutes" that contain finely divided substances capable of holding water may foam as well as butter.

Fly Pupæ in Bottled Milk. *W. A. Riley, Jour. of Dairy Science, Baltimore.*—The writer found in a quart bottle of certified milk, 30 pupæ of *Drosophila ampelophila* attached to the glass. Dr Fetting mentioned a similar occurrence in 1913 in Budapest. The flies lay their eggs on the interior surface of empty bottles, and within less than a week the pupæ emerge, and attach themselves so firmly to the glass that they are not removed even when the bottles, on reaching the dairy, are put through the washing-machine. The writer insists upon the necessity of the returned bottles being washed in the dairy in an almost boiling solution of caustic soda, and urges consumers to wash their bottles as soon as they are empty, and to replace the cap.

Action of Ultra-Violet Rays on Vitamines. *S. S. Zilva, Biochemical Jour., Cambridge.*—The fat-soluble A factor in butter fat is destroyed by an 8 hours' exposure to ultra-violet rays; at the same time the butter is bleached and becomes unfit for consumption. The author therefore asks whether the sterilisation of milk by the ultra-violet rays can decrease its nutritive value.

The antineuritic and antiscorbutic vitamines are not destroyed by ultra-violet rays; in fact, the author has reported that the exposure of neutralised lemon juice for 8 hours to ultra-violet rays did not influence its antiscorbutic activity, and that a similar exposure of autolysed yeast juice did not impair its antineuritic power.

Vitamines in Green Fodder. *T. B. Osborne, L. B. Mendel, E. L. Ferry and A. J. Wakeman, Jour. of Biological Chem.*—The authors have studied the presence in certain green plants, of fat-soluble and water-

soluble vitamins by means of feeding tests on rats. In order to test for each of these vitamins, the product under study was fed in a ration rich in the other kind of vitamin. The following vegetable foods were tested:—leaves and stalks of spinach; whole inside leaves of cabbage; whole young plants of alfalfa, clover and timothy grass; after drying in the air at 50-60°, then finely ground.

The results obtained indicate that 10 per cent. of spinach furnished a little less than the required amount of water-soluble vitamin, while the rats obtained abundance (for normal development) of fat-soluble vitamin; 145 per cent. of cabbage leaf appears to be equivalent to about 10 per cent. of spinach in respect of water-soluble vitamin. Preliminary experiments with the other plants indicate that the content in water-soluble vitamin of clover and timothy grass is similar to that of cabbage, while alfalfa is a little richer. The content of fat-soluble vitamin appears to be very high.

According to the few data at present available, green vegetables supply an important addition to human diet, because the staple foods (cereals, potatoes, sugar, meat, fats, etc.) furnish too limited a quantity of either of these vitamins to satisfy wholly the requirements of an adequate diet.

The Requirements for Growth in Cattle. *A. Gouin and P. Andouard, Comptes Rendus de l'Académie d'Agriculture de France.*—Animals when they have made some growth consume only $\frac{1}{4}$ of the rations fixed by German rules so as to make a certain rate of progress. At an earlier stage the error is smaller, but still appreciable. Wolff and Kellner fixed the quantities of dry matter ingested per day at 2600 gm. per 100 kg. or live weight, for young animals which make indifferent growth. Now in the course of their experiments, the authors found only once, during a period of 10 days only, a subject capable of ingesting 2607 gm. of dry matter per 100 kg. of its weight on special rations. On the whole, animals of over 150 kg. which made a daily gain of 853 gm. consumed 2067 gm. of dry matter per day. The rules exceed the reality by 25 per cent. and lead to theoretical gains much below those obtaining in practice.

All foods do not behave in the same way during digestion. Some, of which the volume is considerable compared with their low feeding value, such as skim milk and roots, do not stay in the stomach long, because the organism soon gets rid of the water with which they are saturated.

Cakes and other concentrates take up little space in the digestive tract. The excreta they produce do not weigh more than the feeding principles they yield to the organism.

The opposite is the case with ligneous fodders. Hay remains a long time in the stomach. It attracts there an enormous quantity of water, the importance of which it appears impossible to appreciate, because a large part of such water is dispersed when the material being digested passes into the intestine. The weight of excreta produced by a very ordinary quality of hay is six times greater than the fraction of this feed utilised in digestion.

Only when we can add to the knowledge of food composition a knowledge of the way in which foods behave in the course of digestion will it be possible to make up a food in which the proportion of bulky fodders will exactly meet the requirements for intensive rearing. If this proportion be too high, it will impede growth; if it is kept lower than necessary, there will be waste of concentrated foods and a serious loss to the breeder.

Importance of Salt in Food Rations of Cattle. *J. Joffe, Jour. of Dairy Science.*—The author purposed to review the literature on this subject, to bring to light the opinions put forward recently on the matter and, if possible, to draw practical conclusions from them. These conclusions may be summarised as follows:—Want of salt in the rations causes pathological conditions and gives rise to a loss of live weight and of vitality and, consequently, a decrease in yield. The experimental data worked out by the author indicate that the necessary amount of salt, according to the rations, should vary between 35.6 gm. and 40.7 gm. per day for each milch cow in the cowhouse. Some foods, such as soya beans and Kafir corn (a variety of sorghum), require a larger amount of salt. At the Agricultural Experiment Station of Kansas only salt obtained by evaporation is used, rock salt being too coarse and irritating.

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Can "Home Grown" Rations Supply the Proteins Necessary for High Milk Production? E. B. Hart and G. C. Humphrey, *Jour. of Biological Chem.*—A ration composed of cereal grains, silage and clover or alfalfa hay is considered by some as sufficiently adequate in protein content for maintaining a high milk production. But in view of the new theory according to which the value (for growth or milk production) of a protein mixture depends upon its qualitative constitution and its quantitative composition and not merely on the quantity of proteins fed, it was necessary to determine directly by metabolism experiments whether the above-mentioned ration, entirely produced on the farm, could furnish protein for a high milk production without draining the protein reserves in the tissues of the animal. The ration used in the experiment was composed of maize stalk silage and clover hay to which ground oats were added in the 1st period of 4 weeks, ground barley in the 2nd period, ground maize in the 3rd, a mixture of approximately equal parts of the three grains in the 4th period, all periods of 4 weeks. The amount of energy provided by the 4 rations was maintained constant by the addition of maize starch. The proportion of grains and starch fed to 3 cows (Nos. 1, 2 and 4) was in conformity to the rule 1 lb. of grain for 3 lbs. of milk; that of grains fed to 2 cows (Nos. 3 and 5) was larger than the normal.

The cows belonged to the Guernsey, Jersey and Holstein breeds. Cows Nos. 1 and 3 were good milk producers, for they gave 34 to 37 pounds of milk daily when the experiment commenced. Although these cows were fed *ad libitum* they had a negative nitrogen metabolism from the beginning of the experiment for 5 or 6 weeks, during which time their milk production decreased gradually to a point where the ration consumed maintained a state of nitrogen equilibrium, which was reached before the end of the second period of 4 weeks.

Cow No. 1, during the 8 weeks when she was put on a ration of oats followed by barley, decreased the amount of nitrogen secreted in the milk by over 100 gm. per week; this quantity decreased by over 150 gm. per week in the case of cow No. 3. On 3rd December cow No. 1 produced 33.8 lbs. of milk, and on 3rd February only 23.7 lbs.; cow No. 3 gave 36.9 lbs. on 3rd December and 25.0 lbs. on 3rd February. Cow No. 2 consumed a large amount of food, but she gave less milk than cows Nos. 1 and 3, which enabled her to maintain herself in nitrogen equilibrium on the grain ration + silage + clover hay. The amount of nitrogen secreted in the milk produced by her during a week scarcely decreased by 60 to 70 gm.; the quantity of milk was also sensibly maintained; it varied only from 23.7 lbs. on 3rd December to 20.1 lbs. on 17th March. These results show clearly that ordinary "home grown" foods suffice only for a moderate milk production. The data given confirm the conclusion that the essential change incident to an intake of protein insufficient both in quantity and quality for nitrogen equilibrium in a milking cow is a rapid decrease in the secretion of milk and not a change in the percentage composition of the milk.

The mixture of oats, barley and maize was not better than rations containing a single grain. During the period of observation the live weight of the animals gave no indication regarding their nitrogen equilibrium. Cows Nos. 1 and 3 lost heavily in weight under conditions of negative nitrogen balance; they changed respectively from 1024 to 935 lbs. and from 885 to 762 lbs. between 2nd December and 20th January.

Cow No. 2 which was in nitrogen equilibrium during the 16 weeks of the experiment did not lose weight, but did not increase appreciably, for she changed from 1088 lbs. on 2nd December to 1109 lbs. on 27th March. Cows No. 4 and 5, although in negative nitrogen balance during 4 or 5 weeks increased in weight respectively from 1356 to 1395 lbs. and from 1135 to 1200 lbs. between 20th January and 17th March.

The animals in negative nitrogen balance decreased their production of milk by 8 to 10 lbs. in 5 or 6 weeks: this amount would have a market value of about 50 cents.

The cost of the addition of 2 lbs. of protein concentrates to the daily ration would therefore have been more than covered.

Conclusion.—A cow with a low milk production and a good appetite can be kept in nitrogen equilibrium with a "home grown" ration, but a good milk-producing cow requires a supplement of protein con-

centrates to avoid loss of nitrogen and consequent decrease in the milk production.

The Influence of Barley on the Milk Secretion of Cows. *F. W. Woll and E. C. Voorhies, Agric. Exper. Stn. Bull., Berkeley, California.*—The authors have furnished complete details of amounts and kind of feeds consumed, the body weights, and the quantity of milk and butter fat produced by—(1) a grade Holstein cow during three lactations in which the only grain fed was barley, and during two in which mixed grains were fed; (2) a pure-bred Jersey, during four lactations, in one of which barley was the sole grain fed; (3) another pure-bred Jersey during two lactations in one of which a mixed grain was given, while barley was fed in the other. The authors also compare the production records of 15 other cows, most of them used previously in similar studies (1) during short periods (generally 5 weeks) of barley feeding, with their production records during the intervening period when they received mixed-grain feeding.

An increased milk flow generally accompanied barley feeding, but the authors do not attribute this to the barley itself, but to the accident that when the cows received only barley feeding they often consumed a larger quantity in comparison with mixed feeding. The authors do not call their trial tests critical experiments, but the tests show that barley feeding has no deleterious effect on milk secretion, as is contended by some breeders of milch cows.

Water Requirements for Milk Production. *A. C. M'Candlish and W. G. Gaessler, Jour. of Dairy Science.*—Experiments carried out at the Iowa Agricultural Experiment Station, United States, with the object of determining the amount of water (exclusive of what is naturally contained in the food) required for milk production during the hot dry summer months by cows fed with fodder harvested on the farm. The cows were watered twice a day; the quantity of water consumed was determined by weighing the animals before and after watering. The moisture in the foods was determined, the amounts fed were weighed. The general results show that water consumption is most important for milch cows. When a cow is fed on fodder and grain, about 350 lbs. of water in the food are consumed per 100 lbs. of milk produced and in addition about 200 lbs. of drinking water will be needed; about 550 lbs. of water will therefore be required per 100 lbs. of milk produced during the summer months.

The Cost of Milk Production Computed on the Year Basis. *F. A. Pearson, Illinois Agric. Exper. Stn. Bull.*—These studies were undertaken to derive workable formulæ that would express the cost of producing fluid milk (for the Chicago market) in terms of amounts of feed and labour used and not of the monetary value of the expenses incurred.

A study of the herd cost is based upon the records during the fiscal years 1914-15 and 1915-16 of 36 farms on which there were 873 milch cows, 225 calves (and heifers not in milk) and 35 bulls, and where 6511 lbs. of milk and 235 lbs. of butter fat were sold per cow during the period. Production in the 6 winter months was 56 per cent. of the yearly total. The gross cost of producing 100 lbs. of milk was found to average \$2.25, the percentage of the several items being: Feed other than pasture 60.7; pasture 5.3; man labour 17; horse labour 3.4; interest on herd 4.9; building charges 3.6; equipment 1.3, and miscellaneous 3.8. A managerial charge was not included. The cost other than for feed (excluding pasture) and man labour totalled 50.16 cents, which almost exactly balanced the 49.69 cents credit from appreciation of stock, manure, hides, beef and other miscellaneous returns. The production cost on these farms can thus be expressed in terms of feed and labour. The amounts per 100 lbs. of milk were approximately 44 lbs. of grain; 188 lbs. of silage and other succulent feed; 50 lbs. of hay; 39 lbs. of other roughage and bedding; 2.42 hours of man labour. This is the formula for "year cost."

To correct for seasonal variations in cost of production it is suggested that the price of any month be that percentage of the year cost which represents the average variation of that month from the average year price during the period 1907-1916. A table showing these monthly percentages

is given. It is noted that only 61.8 per cent. of the grain fed was purchased, whereas in farms providing milk for New York City the purchased grain was about 98 per cent. of the total (A. L. Thompson, Cost of Producing Milk on 184 Farms in Delaware County, New York, in the *New York Cornell Station Bulletin* 364, pp. 109-179, 1915).

In 16 of the above farms, embracing 428 cows, the records permitted the separation of the cost of rearing young stock from the herd cost, the difference being the "cow cost." The net cost of producing 100 lbs. of milk on this basis was \$1.70, which is 215.6 per cent. of the cost of feed (excluding pasture) and man labour. The amounts of feed and labour were, approximately: grain 35 lbs.; silage 140 lbs.; hay 36 lbs.; other roughage 29 lbs., and man labour 2.36 hours. To find the year cost on this basis it is necessary to increase the total of these items by 25.6 per cent. Corrections for seasonal variation may be made as before.

A short discussion of some data from 680 dairy farms in Kane and McHenry Counties in Illinois is given, mainly to show that the "farm cost," obtained by deducting from the total farm expenses the receipts derived from all sources except the dairy, is a misleading measure of milk production costs.

Poisoning of Calves by Iris, observed at Abbotsford, British Columbia. E. A. Bruce, *Jour. of Amer. Vet. Med. Assoc.*—Linnaeus had previously observed that Irises are poisonous to cattle, but cases of poisoning by these plants are rare. Some cases of human deaths caused by eating the rhizomes of *Iris versicolor* in mistake for those of *Acorus Calamus* and several other species considered poisonous because they contain bitter resins and iridine, a purgative glucoside, have been noted. The author has noted 3 cases of poisoning of calves of 3, 4 and 4½ months respectively, which, being shut up in an enclosure, ate the rhizomes of a species of Iris which chanced to lie on the ground; two of them died before the second day and the third succumbed on the 4th day. The principal symptoms were: profuse salivation; inflammation and hardening of the ganglions of the head and neck; appearance of ulcers on the lips and muzzle; acute pain in the belly; faeces tinged with blood shortly before death. Post-mortem examination showed: irritation of the 3rd and 4th stomachs; black spots on the intestines; kidneys, liver and spleen very dark in colour.

Colour Inheritance in Mammals. S. Wright, *Jour. of Heredity*. I.—The author attempts to establish relationship between bio-chemical discoveries relating to melanism and the correlations between different colours described in works on genetics. He proposes a scheme by which the reciprocal relations between the different colours of the coat of mammals can be indicated and he recommends the following classification of colour factors:—

(1) Factors which influence distribution and intensity of colour, largely irrespective of the kind of colour:—

- (a) Factors which influence the distribution of colour in contrast with white;
- (b) Factors which influence the intensity of colour in all coloured parts of the skin, fur, and eyes.

(2) Factors which influence the distribution and the intensity of differentiation from yellow to black, effects naturally visible only in coloured parts:—

- (a) Factors which influence the distribution of a dark colour (black, sepia, brown, etc.) in contrast with yellow;
- (b) Factors which influence the intensity of only the dark colours with effects visible wherever these colours appear (skin, fur, eyes).

II.—Cattle.—The author, considering the inheritance of the colour roan, maintains that the data furnished by Wentworth (*American Breeders Magazine*, No. 4, pp 202-208, 1913; *Journal of Agricultural Research*, Vol. VI., pp. 141-147, 1916) do not confirm the two-factor hypothesis enunciated by that writer, but rather the idea of a single factor without dominance; he explains the exceptions by means of subsidiary hypothesis. The results published by Lloyd-Jones and Evvard (*Research Bulletin* No. 30, *Agricul-*

tural Experiment Station, Iowa State College of Agriculture, 1916), showing that white is independent of red and of black are regarded as contrary to the theory of "polygamous factors" (multiple allelomorphs) enounced by Wilson (*Sci. Proceedings of the Royal Dublin Society*, p. 11, 1918) to explain the roan coat.

Contrary to Wilson (*Sci. Proceedings of the Royal Dublin Society*, pp. 12-66, 1909), the author considers that the colour dun (dull brownish black; the hairs showing a yellowish tip and the yellow colour tending to predominate especially along the mid-dorsal line) is due to a diluting factor combined with black. The same factor combined with red produces yellow or cream. Brindling (that is to say, the presence of irregular black streaks, or of a deeper black if the ground colour is black also) has not been analysed in a satisfactory manner. Piebald is independent of colour, but, on account of the few data available, the interpretation of the factors of the different spots cannot be attempted.

III.—Horses.—In these animals 7 pairs of independent allelomorphs are recognised. Generally the works of the different writers supplement and confirm each other. The author is unable to explain certain facts exhibited by horse hybrids, especially the occurrence of chestnut mules, since that colour has never been seen in the ass and is recessive in the horse.

IV.—Pigs.—The author collects the fragmentary data published on the subject of colour inheritance in these animals. White in Yorkshires is dominant over red and over black, as has been shown by Smith (*American Breeders Magazine*, No. 4, pp. 113-123, 1913), but it differs from the dominant white of other mammals inasmuch as that breed never transmits red when crossed with black, nor black when crossed with red. The author puts forward the idea that, in the case of Yorkshires, white is an extreme dilution of red accompanied by complete absence of extension of black.

The absence of the factor of dilution and the presence of a partial extension of black gives as result a black coloration with the white points of Berkshires and Poland Chinas. A change in minor factors causing an intensity of red and a restriction of black transforms this colour into self red in Duroc Jerseys and in Tamworths. The replacing of the factor "partial extension of black" by the factor "total extension" gives as result a self black coat as in the Essex breed, while the addition of the factors of the white band has for result the coat of the Hampshire breed.

The Feeding Value of Skim Milk for Swine. *H. W. Norton, jr., Mich. Agric. Expert. Stn. Bulls.*—I.—A summary of the results of a large number of feeding trials by different experiment stations throughout the United States was made to determine the value of skim milk as a supplement to maize and other cereal grains when fed to pigs. It is pointed out that 415 pigs fed on cereal grains made an average gain of only 100 lbs. from 486.5 lbs. of grain and that 325 pigs fed on cereal grains supplemented by skim milk made an average gain of 100 lbs. from 266.9 lbs. of grain and 785.1 lbs. of skim milk. This indicates that 100 lbs of skim milk replaced 28 lbs. of grain. Calculated on the basis of \$50 to \$80 per ton for the different grains used, which included maize, wheat, rye and barley, the value of the skim milk ranged from 0.7 to 1.2 cents per pound. Much greater returns were got from the skim milk when 2 to 3 lbs. of milk was fed per pound of grain than when the milk was fed in larger quantities.

II.—This bulletin is an amplification of the preceding one. It is computed that a pound of any of the following supplements would replace the designated amount of grain: skim milk 0.28 lbs.; tankage 2.53 lbs.; middlings 1.05 lbs.; linseed meal 2.62 lbs.; soy-bean meal 2 lbs. Butter-milk is considered to be equal in feeding value to skim milk, and whey about half as efficient.

Inheritance Investigations in Swine. *Kansas Agric. Expert. Stn. Report.*—Cross-breeding experiments with swine gave the following results:—

(1) The wide forehead (Berkshire) is dominant with respect to the medium forehead (Duroc-Jersey) and to the narrow forehead (Tamworth, wild hog); (2) the straight face (Tamworth, wild hog) is dominant with respect to the dished face (Berkshire); (3) the long face (Tamworth) is

¹ See this *Journal*, April, 1918, p. 224.

completely dominant to the short face (Berkshire); (3) the erect ear (Berkshire) is dominant to the drooping ear (Duroc-Jersey).

Experiments made in Austria to Determine the Toxic Action of Chemical Fertilisers upon Sheep. *C. Guntzer and O. von Czadek, Vienna.*—A case of poisoning occurring in Carinthia in a flock of sheep grazing on a meadow recently manured, during wet weather, with basic slag, kainit, and nitrate of soda, has again given rise to the question of the toxic effect exercised by chemical fertilisers upon flocks and herds.

This question is far from settled, and the information met with in the literature dealing with the subject is often contradictory. The Agricultural-Chemistry Experimental Station of the Ministry of Agriculture, in collaboration with the Veterinary College, undertook a series of experiments on sheep, using for the purpose the following chemical fertilisers:—basic slag, superphosphate, 15 and 40 per cent kainit, sulphate of ammonia, nitrate of potassium, nitrate of sodium, etc.

The sheep were given 100 gm of these different compounds in their rations every day.

As regards the basic slag, two out of three experiments had a fatal result. Therefore the writers are of the opinion, notwithstanding certain previous statements to the contrary, that this fertiliser cannot be regarded as innocuous, although, practically, its effects may be less deadly than they proved to be in the experiment, owing to the fact that it is not spread so thickly as to make it possible for the animals to pick up such a large amount as was fed them. In the case of the superphosphate, death supervened in the first experiment (100 gm. of this fertiliser having been given daily) after 8 days, and in another experiment after 11 days. Care must therefore be exercised when land is manured with superphosphate.

Kainit, as results from half-a-dozen experiments, is poisonous if fed in the ratio of 3 to 4 gm. per kg. of live weight. It often produces intestinal inflammation and diarrhoea, which explains the apparently contradictory results of the experiments; for sometimes a relatively small amount has fatal results, while a much larger quantity gives rise to no serious disturbances. This is because, in the second case, most of the kainit is evacuated, owing to the diarrhoea, before it can be absorbed by the intestines.

Sulphate of ammonium, if taken in the proportion of about 4 gm. per kg. of live weight, causes death in a few hours; smaller amounts do not have a fatal result until several days have elapsed.

The fatal dose of sodium nitrate is, for sheep, from 1 to 2 gm. per kg. of live weight; but in this connection we may repeat the remarks made above in the case of kainit.

As regards nitrate of potassium, the experiments, as well as all the results reported in the literature dealing with the subject, show that this fertiliser is very poisonous if taken by sheep in the ratio of 0.75 gm. to 1.50 gm. per kg. of live weight, and nearly always causes death in less than 24 hours. Many factors, however, influence the toxicity of this compound, which depends, firstly, upon the constitution of the animal; and secondly and chiefly, upon the condition of its digestive system, and its capacity of reabsorption.

This is proved by the fact that a 1 per cent. aqueous solution of nitrate of sodium, if swallowed, causes the death of the animal after 20 hours. Evidently, owing to the salt in solution being more easily and rapidly reabsorbed, the toxic action is more pronounced.

The Control of Parasitic Flies on Sheep in Australia by Spraying with Insecticide. *A. H. E. M'Donald, Agri. Gaz. of N.S.W.*—Experiments carried out at Trangie Experiment Farm, New South Wales, Australia, with the object of confirming the efficacy of spraying insecticides on sheep (by forcing a strong jet of the liquid into the wool) as a measure of protection against the blow fly or blue-bottle fly (*Calliphora* spp.), show that, although this treatment does not give complete protection, it, however, reduces considerably the number of sheep attacked, since, on the average, the proportion was 33 per cent. in the flocks treated and 54 per cent. in the untreated flocks.

The insecticides used in the experiments were an arsenical sheep-dip powder, a carbolic dip and a mixture in which the active agent was arsenite of soda. All were applied by means of a very strong jet with a diameter of about $\frac{1}{4}$ inch, using a pressure of about 60 lbs. During the treatment the

wool was not clipped because it was required to hold the insecticide and to enable the maggots present in the wool to be poisoned. The application was repeated a second time six weeks later.

It appears that this treatment localises attacks, but further research is necessary.

Effect of Grazing upon Forest Reproduction. *W. K. N. Sparhawk, U. S. Dept. of Agric. Bull.*—Throughout most of the western United States grazing on absolute forest land is of vast economic importance, and the forester accepts the general principles that grazing must be carried on as a part of forestry management.

A recent study was made by the U.S. Forest Service of the effect of sheep grazing on a number of sample plots on three grazing allotments between 1912 and 1914 in the National Forest of Central Idaho. Sheep injure forest reproduction by browsing and by trampling. Slight browsing of the needles, of side branches, of the leader, or of the bark does practically no damage to the tree, though when repeated it may result in stunted growth or the death of the tree. Severe browsing, such as occurs around bed grounds, often kills the seedlings. Trampling usually is not serious. Damage to seedlings more than a year old is negligible; while as high as 100 per cent.—an average of about 20 per cent. for all plots—were killed when less than one year old. Western yellow pine (*Pinus ponderosa*) is injured the most by browsing, lodgepole pine (*P. contorta*) less so, and Douglas fir (*Pseudotsuga taxifolia*) least. White fir (*Abies concolor*) is practically never browsed. Of 1782 seedlings killed, 73 per cent. were less than a year old, and but 5 per cent. were over 6 inches in height.

Injuries which did not result in death were greater late in the season than during the earlier period, due to drying of the forage as the season advanced. Those killed by grazing were greater earlier in the season than later, as the stem breaks more readily when succulent than after lignification has set in. Injury and death increased fairly constantly with increased intensity of grazing, though after a seedling's third year less than 1 per cent. per year of the trees is killed by grazing of moderate intensity. More than three times as many seedlings are killed by other causes than sheep.

Income Tax and the Farm Management Demonstration Work in Iowa. *S. H. Thompson, Jour. of Farm Economics.*—The Income Tax Act has stimulated thousands of farmers in the keeping of farm records. While the Farm Management Demonstrators in Iowa have been consistently urging the need of keeping records in complying with income-tax requirements, they have recognised that the income-tax matter was not an end in itself but merely a method of approach in the study of the farm as a business. Farm officers were deluged with appeals for help; in too many cases, however, it was not possible to aid the men asking for help in complying with income-tax requirements. Of 76 Iowa farm bureaus that have reported to date, all but three worked with the income tax. The 73 who included the work on income-tax and farm records as a project reached 8806 farms.

Forty-four bureaus worked only with individuals, while twenty-nine assisted both individuals and groups. The bureaus that worked with individuals alone reached on the average 80 each, while those that worked with groups reached one hundred and seventy each. More than 60,000 Iowa farmers, on an average of 600 per county, filed returns this year. Considering the size of the work ahead of the farm bureau the advantage of the group method of work becomes apparent. Meetings held in different parts of the country attended by one hundred farmers would help in solving the problem. These farmers, with the help of the Farm Management Demonstrator and of the county Agent could be assembled for income-tax instruction and analyses of their farm business. The best time for conducting this work is between 1st December and 15th March.

During the present fiscal year Iowa hopes to start a very thorough farm management campaign. As a prelude it is planned to hold a series of district conferences of county agents, where plans for county projects will be fully discussed. It is recognised that varying conditions in the counties will prevent the use of a uniform project. It is contemplated that each county will be given from two to five days of a farm management demonstrator's time for further assistance of the agents through local meetings.

The agent will then personally, or through local demonstrators, extend the work until every township has been given an opportunity to receive instruction on labour income records, cost accounts and income tax.

LEGAL DECISIONS AFFECTING AGRICULTURE.

SEVERAL cases interesting to agriculturists have been decided by the Courts recently. The following have been selected as settling points of principle as well as being of general interest:—

ARBITRATION PROCEEDINGS UNDER THE AGRICULTURAL HOLDINGS (SCOTLAND) ACT, 1908.

Single Arbitrator—Claim not timeously lodged. *Roger v. Hutcheson and Greenshields.*—This was an action at the instance of Henry Stevenson Roger, outgoing tenant of the farm of Manorhill, Roxburghshire, against William Hutcheson, farmer, Courthill, Kelso, oversman, and Thomas Greenshields and Thomas Steel Greenshields, ingoing tenants, and Hugh James Elibank Scott Makdougall, proprietor. The Pursuer, the outgoing tenant, renounced his lease of the farm as at Whitsunday 1919 on the footing that he would be entitled to the benefits of an ordinary waygoing including the usual compensation for unexhausted manures and feeding stuffs. Messrs Greenshields, who took entry to the farm at Whitsunday 1919, undertook liability for the landlord's obligations to the outgoing tenants so far as such compensation was concerned. A Submission was prepared to two Arbitrators and an Oversman in which the nature of the claims was referred to in general terms but no definite claim was lodged as provided for in the Act. The Arbitrators disagreed and called in the Oversman, Mr William Hutcheson, who declined to deal with the claim for compensation under the Agricultural Holdings (Scotland) Act, 1908, on the ground that it fell to be decided by a single arbitrator in terms of Section 11 (1) of that Act. The Pursuer brought the action to have it declared that the Oversman must proceed to fix the compensation in terms of the Submission. In their defences the incoming tenants claimed that no timeous notice of the claim for compensation for unexhausted manures, etc., had been lodged.

On 10th November 1920 the Lord Ordinary (Lord Sands) dismissed the action. In the course of his judgment his Lordship stated that there were two questions of law, the ultimate decision of which rested with the Court—viz.

- (1) Whether it was competent under such circumstances as here obtained to refer a claim for compensation for improvements under the Agricultural Holdings Act, 1908, to two referees and an oversman, and
- (2) Whether in the present case the requirements of the statute as to the date of lodging a claim had been sufficiently complied with.

After quoting Section 11 (1) of the Act, his Lordship stated that he was of the opinion that, having regard to the object of the legislature and to the fact that the compensation is purely statutory and is recoverable under a statutory code, a reference to two arbitrators is null or at least voidable at the instance of either party, as being made in disregard of a statutory direction. He was of opinion that the fact that the reference was entered into not by the outgoing tenant and the landlord, but by the outgoing tenant and the incoming tenant who had taken over the landlord's obligations, made no difference. The arrangement was a common one and was contemplated by the Act (Section 7) and it would go far to defeat the object of the provision requiring the reference to be to a single arbitrator if this provision were held not to apply to such a case.

As regards the second question, by Section 6 (2) it is provided:—"A claim by a tenant of a holding for compensation under this Act in respect of any improvements comprised in the first schedule to this Act shall not be

made after the determination of the tenancy." The facts were as follows:—The landlord agreed to accept a renunciation of the lease as at Whitsunday-Martinmas 1919, the outgoing tenant to have waygoing privileges as if it were the natural expiry of the lease. Upon 30th January 1919 the Agents of the Pursuer, the outgoing tenant, wrote to the Agents of the landlord:—"We shall put in hand the preparation of a claim on behalf of Messrs Roger for compensation under the Agricultural Holdings Act and hope to communicate with you further on the subject later on." The claim here adumbrated on was not presented to the landlord or to the incoming tenant until long after Martinmas 1919, the date of the termination of the tenancy as regards the requirement for making a claim. The deed of submission was duly prepared and was executed upon 26th-27th May 1919, and it contained *inter alia* as matters referred: "(Sixth) What sum shall be payable by the second party representing and undertaking responsibility for the said Hugh James Elibank Scott Makdougall proprietor of the said farm of Manorhill to the first party as compensation for improvements under the Agricultural Holdings Act." It appeared to his Lordship that this clause did no more than leave open, or at the most adumbrate a claim. It did not certify the existence of a claim. The outgoing tenant had still six months to prepare and tender a claim. Nothing more, however, was done until long after Martinmas. His Lordship distinguished between the Notice of Claim required under the Act of 1883 (Section 7) and the Claim required under Section 6 (2) of the Act of 1908, and was of opinion that it was not sufficient for an outgoing tenant merely to indicate an intention to make a claim with no further specification than perhaps a reference to certain heads of improvement mentioned in the schedule—*e.g.* as in the present case "Compensation under the Agricultural Holdings Act" or "Valuation of Unexhausted Manures, etc." His Lordship accordingly was of opinion that the answer to both of the questions before the Court was in the negative and he dismissed the action.

Lord Sands' judgment in this Case is likely to have practical important results as it is a common practice in a reference to two arbiters and an oversman to settle waygoing valuations of sheep stock, crops, etc., which is valid under the 1910 Act, to slip in compensation claims.

Appeal on Stated Case—Sheriff's Opinion Final. *Sir J. E. Johnson-Ferguson v. the Board of Agriculture for Scotland.*—A Note of Appeal from the Findings of the Sheriff in a Special Case was decided by the Second Division of the Court of Session on 17th November 1920. It arose out of an arbitration under the Corn Production Acts and the Agricultural Holdings Act, 1908. The facts were as follows:—In an arbitration under the above-mentioned Acts between Sir Jabez Edward Johnson-Ferguson of Springkell and another, proprietor of Springkell, and the Board of Agriculture for Scotland, Mr Robert Macmillan of Woodlea, Moniaive, was appointed Arbiter to determine the amount and mode and time of payment of the compensation to be paid by the Board in respect of various claims by the Appellants for loss sustained through carrying out an Order of the Board dated 15th February 1918 for the cultivation of certain grass parks forming part of the policy grounds of Springkell estate, for loss the Claimants estimated they would sustain in bringing the grass parks back to their former condition, and for sums expended in carrying out the Order. The Arbiter issued Proposed Findings against which the Appellants lodged representations and called upon the Arbiter in the event of his not being able to give effect to them to state a Case for the Opinion of the Court. The Arbiter stated a Case to the Sheriff at Dumfries. After hearing Counsel, Sheriff Morton answered the questions the Arbiter had stated. The proprietors appealed, and the Division held that the Appeal was incompetent as under the Corn Production Acts, which incorporated only the arbitration provisions of the Agricultural Holdings (Scotland) Act, 1908, the decision of the Sheriff was final.

The Lord Justice-Clerk, who gave the leading judgment, said that the present Appeal was taken on the footing that the Act of Sederunt which applies to Appeals under the Agricultural Holdings Act applied. The Corn Production Act of 1917, in so far as it required to be referred to in the case, contains Section 9 (10) and Section 11 (1). Section 9 (10) says: "The

amount recoverable or payable by the Board under Subsection (8) or Subsection (9) shall be determined in each case in default of agreement by arbitration under this Part of this Act," that is under the Fourth Part of the 1917 Act. And then Section 11 (1) says:—"Arbitrations under this Part of this Act shall be before a single arbitrator under and in accordance with the provisions of the Second Schedule to the Agricultural Holdings Act, 1908, etc." It appeared to his Lordship quite clear that all that is referred to and all that is introduced into the procedure under the Corn Production Act is the Second Schedule of the Act of 1908, which Schedule in itself is a complete code and provides a guidance to the arbitrator in these terms. Section 9 says:—"The Arbiter may at any stage of the proceedings, and shall if so directed by the Sheriff (which direction may be given on the application of either party) state in the form of a Special Case for the Opinion of the Sheriff any question of law arising in the course of the arbitration." It was noticeable that the arbitrator's powers or the duty laid upon him was to state a Case and to state it for the Opinion of the Sheriff and nothing else. His Lordship thought on the Schedule that the Opinion that is given is not a matter of appeal at all. He was unable to make any distinction between this Case and that which was referred to in the argument, the well-known case of *Lady Cathart*. The ground of judgment there was that jurisdiction was given to the authority whose opinion was to be asked—the Lord Ordinary instead of the Sheriff as here; and that was a jurisdiction which began and ended with the opinion of the person whose opinion was to be sought.

In view of Section 5 of the Agriculture Act 1920 an opinion of the Sheriff in an arbitration under Part IV. of the Corn Production Act of 1917 is now appealable to either Division of the Court of Session from whose decision no appeal shall lie, except with leave of that Court.

Arbitration Construction—Functions of Arbiter. *Mitchell-Gill v. Buchan*—In an arbitration under the Agricultural Holdings (Scotland) Act, 1908, between Andrew John Mitchell-Gill of Savoch, Aberdeenshire, the landlord of the holding of Savoch, and William Alfred Buchan, the outgoing tenant, the landlord presented an Application to the Sheriff craving the Court to direct the Arbiter (James E. Esslemont) to state a Special Case for the Opinion of the Sheriff upon certain questions of law which had arisen in the course of the arbitration. The Sheriff-Substitute (Laing) directed the Arbiter to state a Case, and on the Case being stated answered the question put in the affirmative. The landlord appealed, and the First Division recalled the Interlocutor of the Sheriff-Substitute and answered the question in the negative. The Arbiter, after considering the Interlocutor, proposed to disregard the Opinion. In a further Stated Case the Questions of Law for the Opinion of the Court were as follows:—

1. Is the Arbiter bound to give effect to the said Interlocutor of the First Division of the Court of Session by finding that the landlord did not terminate the tenancy without good and sufficient cause, and for reasons inconsistent with good estate management, and to refuse the tenant's claim in so far as relating to compensation for unreasonable disturbance?
2. Is the Arbiter in spite of said Interlocutor entitled to entertain and proceed with the assessment of said claim?

The Sheriff-Substitute *inter alia* answered the first Question of Law in the negative and the second in the affirmative.

The landlord appealed to the First Division of the Court of Session and the Court recalled the Interlocutor of the Sheriff-Substitute, answered the first Question of Law in the affirmative and the second in the negative, and remitted to the Arbiter to proceed.

In giving the leading Opinion, the Lord President (Clyde) stated that when it is said that an arbiter in Scotland is the final judge both of fact and law he must take the facts as they are presented to him and the law as it is. He may err both in interpreting the evidence before him and in applying the law to the facts which he thinks are proved; and he being the final judge on the subject matter of the submission any such errors and mis-

understandings into which he may innocently fall cannot be corrected. But that is all that is meant by saying that he is the final judge of fact and law.

OFFICIAL ORDERS AND CIRCULARS

The following notice was recently issued to the Press:—

OFFICIAL IMMUNITY TRIALS

The Board of Agriculture for Scotland announce that they are now making arrangements for the continuance during the coming season of the trials conducted by them for the testing of new varieties of potatoes for immunity from Wart Disease.

Wart Disease of Potatoes.

Growers or merchants who have stocks of new varieties which they desire to have tested for this purpose should forward to the Director of the Seed Testing Station, 7 Albany Street, Edinburgh, a sample consisting of 12 tubers of each variety. A note of the name or reference number allotted to the variety should be enclosed with each sample, and when more than one sample is forwarded the tubers of each variety should be carefully packed to prevent mixing.

A fee of 5s. will be chargeable in respect of each sample forwarded for inclusion in the trials. This fee will cover the testing of a sample for the full period necessary to determine its susceptibility to or immunity from Wart Disease. As experience has shown that a variety which has escaped attack by Wart Disease during the first season's test may subsequently prove to be susceptible, no certificates of immunity will be issued in respect of any new variety included in the trials, unless it has been tested for two successive years, and in both seasons is found to be unaffected by the disease.

In order that raisers of new varieties may be assisted in eliminating from their stocks at an early stage those seedlings that are susceptible to Wart Disease, the Board are prepared to test free of charge single tuber samples of *bona fide* seedlings not more than two years old. Single tuber samples will only be accepted from the actual breeders of the seedlings and in general not less than 20 samples will be accepted from any one breeder. All samples for the single tuber test should reach the Director of the Seed Testing Station not later than 15th March.

In addition to the immunity tests, the Board are prepared to undertake the testing of samples of potatoes for the purpose of determining their variety. Samples submitted for testing for this purpose should consist of not less than 12 (twelve) tubers. The fee for this test will be 5s. per sample.

Facilities will also be afforded for the testing of samples of merchants' or farmers' stocks with a view to furnishing a report on their purity and immunity from Wart Disease. Such samples should be forwarded in lots of 28 lbs., and a fee of £1, 1s. will be chargeable for the testing of each sample.

NOTE.—All fees chargeable should be remitted at the same time that the samples are forwarded to the Director of the Seed Testing Station.

The following is a list of the immune varieties of potatoes approved for planting in 1921:—

EARLY VARIETIES.

A1 (Sutton), America, Arran Rose, Ashleaf (Broadleaf) or Ashleaf (Sutton),¹ Coronation, Crown Jewel, Dargill Early, Boston Kidney, Resistant Snowdrop, Snowdrop, Witch Hill.

SECOND EARLY VARIETIES.

Adironack, Ally, Arran Comrade, Border Queen, Climax, The Towse, Towser, Conquest, Crimson Beauty, Mr Bresse, Early Market, Early Pink Champion, Edzell Blue, Entente Cordiale, Great Scot, Southampton Wonder, Sir Douglas Haig, Katie Glover, King George, Mauve Queen, Nithsdale, Schoolmaster, Snowball, The Dean, The Duchess.

¹ Myatt's and other "Ashleaf" varieties are susceptible.

LATE OR MAINCROP VARIETIES.

Abundance, Arran Victory, Bishop, Burnhouse Beauty, Captain Cook, Catriona, Champion, Clan Alpine, Crusader, Dominion, Flourball, Golden Wonder, Irish Chieftain, Irish Queen, Irish Strain, K. of K., Kerr's Pink, King of the Russets, Langworthy, What's Wanted, Leinster Wonder, Lochar, Heather Bountiful, Majestic, Rector, Rhoderic Dhu, Shamrock, St Malo Kidney, Supreme, Templar, The Laird—Tinwald Perfecton, Rob Roy, White City, Carnegie, Di-Vernon.

THE FOLLOWING ARE "ABUNDANCE" TYPE:—

Admiral, Balthayock, Balmuir, Bloomfield, Charles Downing, Crowner, Culdees Castle, Farquhar's Surprise, Favourite, Her Majesty, Holyrood, Kerr's White, King Albert, Laing's Prolific, Montrose Delight, Osborne Seedling, Priory Queen, Secundus, The Crofter, The Provost, Tillycorthie Seedling, Twentieth Century, Waverley, Jeanie Deans.

The following letter was circulated by the Board through the Agricultural Executive Committees:—

Rats and Mice (Destruction) Act, 1919.

Sir,—I am directed by the Board of Agriculture for Scotland to transmit herewith for your guidance a leaflet¹ relative to the provisions of this Act, and to state that they desire to impress upon **Destruction of Rats.** occupiers of agricultural land the importance of doing all within their power to fulfil the duties which the Act imposes on them.

Rats in their present numbers cause serious damage to food-stuffs and material; and it is estimated by competent authorities that the loss so occasioned in Great Britain, apart altogether from the losses sustained through the harmful influence of the vermin upon public health, amounts to between ten and fifteen million pounds annually. When also it is remembered that rats are largely responsible for the spread of animal diseases such as trichinosis, influenza (in horses), foot-and-mouth disease, and dysentery, it should become plain to farmers that continual and systematic effort to reduce the number of rats on their premises is true economy.

The necessity of adopting intensive measures for rat destruction is further emphasised by the fact that these vermin thrive in rural areas to the number of millions; their rate of reproduction is such that, assuming no casualties and an adequate food supply, the progeny of a pair of rats might, at the end of two years, number some 90,000.

The Board appeal to occupiers of agricultural land to take systematic steps to free their premises from the vermin. This is a responsibility already laid upon occupiers by the above-mentioned Act. If occupiers experience difficulty or require advice they should apply to the Local Authority for their area. I am, Sir, your obedient servant,

CHAS. WEATHERILL, *Secretary.*

The following circular letter was recently sent to Local Authorities:—

Rats and Mice (Destruction) Act, 1919.

Sir,—I am directed by the Board of Agriculture for Scotland to state that they have had under consideration the question of the extermination of rats and mice during threshing operations. It is common knowledge that large numbers of rats and mice find harbourage in unthreshed stacks and the consequent damage to food-stuffs is considerable. This is particularly the case where stacks have not been built on "staddles".

The threshing season thus provides an opportunity for the extermination of rats, and many farmers have adopted the following plan with success. Each stack, before threshing is commenced, should be surrounded by a rat-proof fence of fine meshed wire not less than 4 feet in height. The distance of the wire from the stack should be about 8 feet, and the wire should be bent inward towards the stack.

¹ Leaflet No. 51 issued by the Board. See this *Journal* for July, 1920, p. 337.

The Board are advised that in terms of Section 1 of the Rats and Mice (Destruction) Act, 1920, this method of extermination can be regarded as a necessary and reasonably practicable step for the destruction of rats and mice or for preventing land from becoming infested. They consider, therefore, that farmers should be encouraged either to provide themselves with the necessary wire-netting or to make arrangements with their neighbours or threshing-mill owners for the fencing of stacks during threshing operations.

The Board would be glad to be favoured with the views of your Council on this proposal, and to be informed whether the Council are prepared by public notice in terms of Section 4 of the Act and otherwise to advocate its adoption by farmers. I am, Sir, your obedient servant,

CHAS. WEATHERILL, *Secretary*.

The following notice was recently issued to the Press :—

CONSTITUTION OF DISTRICT AGRICULTURAL WAGES COMMITTEES.

The Board of Agriculture for Scotland announce that the District Agricultural Wages Committees constituted after the passing of the Corn

District Wages Committees.

Production Act, 1917, whose principal statutory duty is to fix minimum rates of wages for workmen in agriculture within their respective districts, will go out of office on 31st March next, and that arrangements are now being made for the formation of new committees to take up office as from 1st April.

For the purpose of certifying representative joint Committees (comprising a Chairman and representatives of employers of agricultural labour and of workmen employed in agriculture in equal numbers), the Board originally divided Scotland into twelve districts, and these districts will be retained for the new District Committees now to be formed.

For the purpose of determining who are workmen employed in agriculture, the Act of 1917 defines "workmen" as including "boys, women and girls," and agriculture as *including* the use of land as grazing, "meadow, or pasture-land, or orchard, or osier land or wood-land, or for market gardens or nursery grounds"—*i.e.* in addition to the ordinary meaning of arable cultivation.

The Act contemplates the District Committees being formed by local initiative, but empowers the Board to fix a date by which, if no effective District Committee has been so formed, it will be the duty of the Board to form a committee for the district. As the District Committees grouped in combinations of districts have to elect the Central Wages Committee, whose period of office also expires on 31st March, the Board have fixed the 26th March 1920 as the date by which District Committees should be formed.

The Board have prepared an explanatory memorandum for the guidance of employers and workmen in agriculture in which the names of the "returning officers" for the respective Districts are given, and indicating the procedure to be adopted in electing the new District Committees.

Copies of this memorandum may be obtained free of charge on application to the Secretary of the Board at 29 St Andrew Square, Edinburgh.

The constitution of the District Agricultural Executive Committees was prescribed by an order issued by the Board under the **Agricultural Executive Committees.** Corn Production Acts, 1917 and 1920. The provisions of the Order, which is dated 18th March 1921, are as follows :—

THE CULTIVATION OF LANDS (SCOTLAND) REGULATIONS, 1921.

1. The persons who on the first day of January nineteen hundred and twenty-one are members of an Agricultural Executive Committee constituted by the Board, with the approval of the Secretary for Scotland, for any district or area, shall be the members of the first Agricultural Committee constituted under these regulations for the said district or area. They shall come into office on the said day, and shall hold office until the first day of

January nineteen hundred and twenty-three, when a new Agricultural Committee shall be elected in a manner to be prescribed hereafter.

2. Each Committee shall have an Executive Officer who shall also act as Secretary and shall give his whole time to the work. Such officer may be appointed to serve one or more Committees. These officers will be appointed by the Committee subject to the approval of the Board. The Board shall determine which Committees are to be served by an officer or officers in common.

3. A Committee constituted under these regulations for any administrative county may, with the consent of the Council of any burgh or police burgh which is surrounded in whole or in part by the county, exercise within that burgh the powers which the Committee is empowered by Statute and the duties which it is authorised by the Board to exercise within the county, or any of such powers and duties; and for the purposes of the exercise of the said powers and duties within the burgh, the Committee and the Council of the Burgh may appoint, in such manner as may be agreed, a Committee to act as a Sub-Committee of the Agricultural Committee, but all decisions of the Sub-Committee shall be submitted to the Committee for their approval before action is taken.

4. (1) Accounts shall be kept by an Agricultural Committee of their receipts and expenditure, and be open to inspection by any officer of the Board, and those accounts shall be made up and audited in such manner as the Board shall direct.
- (2) An Agricultural Committee shall appoint a Chairman of the Committee. At any meeting at which the Chairman is not present a person appointed by the meeting shall be entitled to act as Chairman of the Committee. At any meeting of a Committee the Chairman shall, in case of an equal division of votes, have a second or casting vote.
- (3) The quorum, proceedings and place of meeting of an Agricultural Committee shall be such as the Committee determine
- (4) The proceedings of an Agricultural Committee shall not be invalidated by any vacancy among its members or by any defect in the appointment or qualification of any of its members
- (5) A vacancy among the members of a Committee shall be filled by a suitable person appointed by the Committee and approved by the Board.
- (6) Minutes of the proceedings of an Agricultural Committee shall be kept in a book provided for that purpose, and a minute of those proceedings signed at the same or the next ensuing meeting by the chairman of the meeting at which the minute is signed shall be received in evidence without further proof
- (7) Any notice, direction or other instrument signed by the Chairman and the Executive Officer of an Agricultural Committee shall be received in evidence without further proof as a notice, direction or instrument issued by the Committee
5. These regulations apply only to Scotland.

Under Part IV. of the Corn Production Act, 1917, the Board have made the following regulation, which was issued on 18th March 1921:—

Arbitration

THE CULTIVATION ARBITRATIONS (SCOTLAND) ORDER, 1921.

The time within which any person aggrieved by a notice may, under Sub-section (1) of Section 4 of the Agriculture Act, 1920, require any question to be referred to arbitration, shall be fourteen days from the date of service on him of the notice or a copy thereof.

STATISTICS.

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS
in December 1920, and January and February 1921.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	DECEMBER.			JANUARY.			FEBRUARY.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	122 0	111 9	83 10	120 11	112 4	83 11	117 8	110 2	83 8
Shorthorn ...	114 6	105 0	85 6	115 6	109 0	84 6	113 6	107 6	82 9
Galloway ...	114 1	107 5	100 10	109 6	104 0	97 9	110 3	104 0	97 6
Ayrshire ...	100 0	85 0	60 0	104 5	85 0	65 0	100 0	80 0	60 0
Cross-bred ...	117 0	108 4	86 6	117 3	109 11	88 0	114 3	106 7	85 11
Blue Grey ...	116 8	107 7	100 10	109 6	104 0	97 9	109 9	104 0	97 6
Highland ...	108 8	92 6	...	...	...	...	...	...	...
VEAL CALVES ...	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
	19½	15	12	20	14½	11½	19	13½	9
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot ...	26½	25	21½	26½	25½	21	26½	24½	21½
Half-bred ...	26½	25½	20½	26½	25½	20½	26½	25	20½
Blackface ...	24½	22½	19½	24	22½	18½	23½	22	19
Greyface ...	26½	24½	19	26½	24½	18½	25½	24½	19
Down Crosses ...	26½	26	...	26½	25½	...	26½	25½	...
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs ...	25 2	22 7	18 7	24 1	21 10	17 3	22 9	20 6	16 8
Porkers ...	25 3	23 0	18 7	24 6	22 3	17 6	23 0	20 9	17 0

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

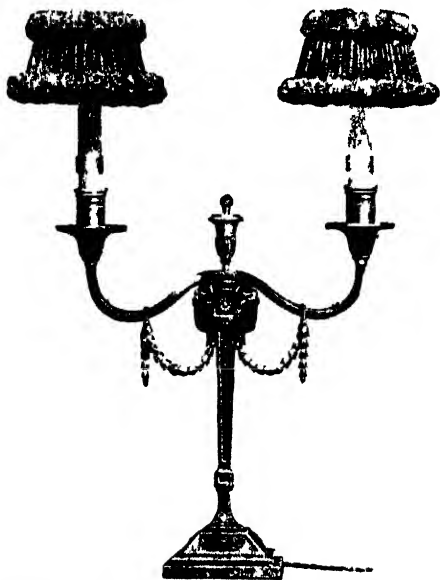
Description.	DECEMBER.			JANUARY.			FEBRUARY.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
STORE STOCK:—									
STORE CATTLE—									
Aberdeen-Angus:	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.
Yearlings ...	£ s. 33 8	£ s. 23 11	£ s. 15 7	£ s. 35 12	£ s. 22 5	£ s. 14 10	£ s. 32 7	£ s. 25 3	£ s. 16 4
Two-year-olds ...	45 16	32 16	27 5	50 3	37 8	...	47 11	37 14	28 13
Shorthorn:									
Yearlings ...	...	...	...	...	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Galloway:									
Yearlings ...	25 0	21 0	15 5	...	21 0	15 0	...	...	18 0
Two-year-olds ...	38 7	33 7	29 0	...	35 0	28 0	...	33 0	...
Ayrshire:									
Yearlings ...	...	...	...	...	14 0	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Cross-bred:									
Yearlings ...	26 7	20 12	13 18	26 13	19 18	14 11	28 1	22 7	15 9
Two-year-olds ...	43 3	35 12	28 7	44 16	36 10	27 0	46 0	37 4	28 18
Blue Grey:									
Yearlings ...	...	...	...	...	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Highland:									
Yearlings ...	16 5	13 18	10 15	...	...	...	...	...	...
Two-year-olds ...	23 15	20 13	19 3	...	...	...	...	...	...
Three-year-olds ...	42 10	36 10	29 10	...	...	...	...	...	...
DAIRY COWS—									
Ayrshire:									
In Milk ..	66 8	51 19	29 0	68 13	51 10	27 6	59 11	47 2	26 5
Calvers ...	68 5	50 16	33 7	67 2	49 5	29 19	61 14	46 17	29 13
Shorthorn Crosses:									
In Milk ...	73 19	57 4	38 0	77 2	60 16	42 3	75 18	61 2	42 7
Calvers ...	70 6	53 14	36 11	66 2	50 8	35 7	65 11	50 7	34 19
STORE SHEEP—									
Cheviot Hogs	£ s. d. 89 0	£ s. d. 63 3	£ s. d. 37 0	£ s. d. 95 0	£ s. d. 55 0	£ s. d. ...	£ s. d. 93 0	£ s. d. 72 4	£ s. d. 52 4
Half-bred Hogs	113 8	94 5	60 0	129 11	100 2	80 0	134 7	98 9	77 9
Blackface Hogs	90 6	73 6	53 4	67 10	45 5	32 8	69 7	51 5	32 3
Greyface Hogs	...	68 0	52 0	93 5	72 6	53 8	96 3	78 11	59 4
STORE PIGS—									
(6 to 10 weeks old)	80 9	59 8	...	82 4	59 7	...	83 7	55 9	...

THE SCOTTISH JOURNAL OF AGRICULTURE [APRIL]
VERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH,
AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	December.			January.			February.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF:—		per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.
Home-fed—		d.	d.	d.	d.	d.	d.	d.	d.	d.
Bullock or Heifer ...	1	18½	18½	19½	19½	20½	19½	18½	19½	19½
	2	18½	16½	18½	18½	18½	19½	18½	17½	18½
Bull	1	17½	18	16½	18½	19½	17½	17½	18½	16½
	2	17½	17½	15½	17½	18½	16½	16½	17½	15½
Cow	1	14½	15½	15½	16½	17½	16½	15½	15½	16½
	2	12½	14	13½	14½	15	15½	14½	14	14½
Irish—										
Bullock or Heifer ...	1	18	...	17½	18½	...	18½	18½	...	18½
	2	17½	...	17	18	...	17½	17½	...	17½
Bull	1	...	...	15½	...	...	16½	...	...	15½
	2	...	...	14½	...	...	15½	...	...	14½
Argentine Frozen—										
Hind Quarters ...	1	12	12	12	...	12	12	12	12	12
Fore " ...	1	8	8	8	...	8	8	8	8	8
Argentine Chilled—										
Hind Quarters ...	1	...	...	12	...	...	...	...	...	12
Fore " ...	1	...	...	8	...	...	...	...	...	8
Australian Frozen—										
Hind Quarters ...	1	...	...	...	12	...	12	12	...	...
Fore " ...	1	...	...	...	...	...	8	...	...	...
Canadian Frozen—										
Hind Quarters ...	1	...	...	...	...	...	...	...	...	...
Fore " ...	1	...	...	...	...	...	...	...	...	...
New Zealand Frozen—										
Hind Quarters ...	1	...	...	...	11½	...	12	...	...	...
Fore " ...	1	...	...	...	7½	...	8	...	...	...
Uruguay Frozen—										
Hind Quarters ...	1	...	...	...	...	...	...	...	...	...
Fore " ...	1	...	...	...	...	...	...	...	...	...
MUTTON:—										
Hoggs, Blackface ...	under 60 lb.	24	23½	24	24	23½	24½	23½	22½	24½
	60 lb. and over.	23	22½	23½	23	22	23½	22½	21½	23½
" " Cross ...	60 lb. and over.	24	23½	24	24	23½	24½	23½	23½	24½
	60 lb. and over.	23	22½	23	23	22½	23½	22½	21½	23½
Ewes, Cheviot ...	1	19½	19½	19½	19½	19½	19½	19½	19½	19½
	2	18½	...	18½	18½	...	19	18½	...	19
" " Blackface ...	1	19½	...	19½	19½	18	19½	19½	...	19½
	2	18½	...	18½	18½	...	18½	18½	...	18½
" " Cross ...	1	19½	18½	18½	19½	18½	19½	19½	18	18½
	2	18½	16	18	18½	...	18½	18½	...	18½
Argentine Frozen	1	...	9	...	9	...	...	9	...	...
Australian " ...	1	...	8½	8	9	...	...	9	...	...
	2	...	6	6	6	...	...	6	...	...
New Zealand "	1	9	9	9	...	...	...	...	...	...
	2	...	6	6	...	...	...	...	...	...
LAMB:—										
Home-fed ...	1	26	...	24½
	2	25	...	23½
Argentine Frozen	1	13
New Zealand "	1	13	13	13	...	13	...	13

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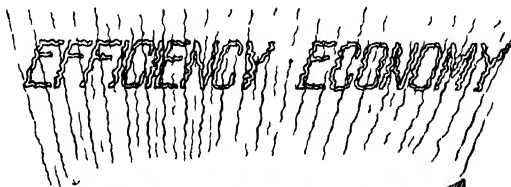
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AVERAGE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporter.)

Description.		Quality.		Dec.		Jan.		Feb.		Description.		Quality.		Dec.		Jan.		Feb.	
				s. d.		s. d.		s. d.						s. d.		s. d.		s. d.	
BUTTER :																			
Irish Creamery ... per cwt.		1		393	7	322	2	298	8	BACON (continued) :		1		192	0	178	8	153	11
" " (Unsalted) "		1		457	0	420	0	...	...	American Sides ... per cwt.		1		190	0	177	9	162	9
Canadian ... "		1		336	0	326	8	298	8	" Cumberland Cut "		1		225	0	211	6	187	9
" (Unsalted) "		1		336	0	326	8	298	8	Canadian, Sides ... "		1		230	0	218	6	208	6
Danish ... "		1		336	0	326	8	298	8	" Danish, Sides ... "		1		336	5	273	6	265	0
" (Unsalted) "		1		336	0	326	8	298	8	HAMS Irish (Smoked)		1		220	0	202	9	185	6
Australian ... "		1		336	0	326	8	298	8	American, Long Cut		1		220	0	200	0	180	0
" (Unsalted) "		1		336	0	326	8	298	8	" Green' ... "		1		220	0	200	0	180	0
New Zealand ... "		1		336	0	326	8	298	8	American, Short Cut		1		...	...	185	6	185	6
" (Unsalted) "		1		336	0	326	8	298	8	Canadian, Long Cut		1		5	4	5	1	3	11
Argentine ... "		1		336	0	326	8	298	8	English County' ... per doz.		2		...	...	...	...	3	8
" (Unsalted) "		1		336	0	326	8	298	8	Irish ... per 120		2		53	4	44	4	37	3
CHEESE :																			
Cheddar ... "		1		150	5	163	0	161	0	" Duck ... "		1		37	6	31	9	...	...
" ... "		2		140	5	...	...	...	...	" Pickled ... "		1		...	...	36	4	...	...
Cheddar Loaf ... "		1		172	0	...	...	...	...	American ... "		1		...	...	...	...	...	...
Dunlop ... "		1		133	0	150	6	148	0	" (Stored)		1		38	6	...	...	...	...
" ... "		2		118	10	...	...	...	...	Argentine ... "		1		40	0	38	3	32	0
Canadian ... "		1		154	0	160	0	159	3	" ... "		2		...	...	...	...	30	0
New Zealand ... "		1		163	4	163	4	157	6	Canadian ... "		1		...	...	38	8	...	...
BACON :																			
Ayrshire (Rolled) ... "		1		287	2	277	6	263	1	" (Stored) ... "		1		41	0	...	...	...	...
Irish (Green) ... "		1		254	0	233	9	225	0	Chinese ... "		1		35	9	30	7	...	...
" (Dried or Smoked) "		1		274	0	251	9	240	0	Danish (Fresh) ... "		1		53	4	45	7	40	0
" (Long Clear) ... "		1		274	0	245	0	232	6	" ... "		2		52	6	44	2	39	0
Wiltshire (Green) ... "		1		254	0	233	9	225	0	" (Pickled) ... "		1		37	3	34	0	...	...
" (Dried or Smoked) "		1		274	0	252	6	240	0	Egyptian ... "		2		36	3	...	...	...	...
American, Long Clear		1		202	0	198	6	195	0	" ... "		1		...	...	...	...	22	6
Middles (Green) ... }		1		...	...	...	...	...	...	Moroccan ... "		2		...	...	...	...	21	6
American, Short Clear		1		191	0	193	0	195	0	Roumanian ... "		1		39	0	30	2	25	0
Backs ... }		1		...	...	...	...	...	...	Styrian ... "		1		...	...	38	6	28	0
American, Bellies ... }		1		191	0	193	0	195	0	" ... "		2		...	...	...	...	30	0

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH,
AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

MARKETS.	Quality.	DECEMBER.					
		Second Earlies.	LATE VARIETIES.				
			Red Soils.		Other Soils.		
			Lang- worthy.	Other.	Lang- worthy.	Other.	
		per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	
Dundee	First ...	...	...	...	...	7 4 7
	Second ...	...	...	...	...	7 0 0
Edinburgh...	First ...	...	12 0 0	8 14 7	...	7 17 2
	Second ...	...	...	...	...	...
Glasgow	First ...	...	9 0 0	9 10 0	...	9 0 0
	Second ...	...	...	...	...	...
JANUARY.							
Dundee	First ...	...	...	...	...	7 1 3
	Second ...	...	...	...	...	7 0 0
Edinburgh...	First ..	...	...	...	...	7 11 3
	Second ...	...	...	...	...	...
Glasgow	First ...	...	...	...	...	9 0 0
	Second ...	...	...	...	...	...
FEBRUARY.							
Dundee	First ...	...	...	...	...	6 0 0
	Second ...	...	...	...	...	5 15 0
Edinburgh...	First ...	...	10 15 0	...	...	6 2 6
	Second ...	...	...	...	...	...
Glasgow	First ...	...	...	...	...	7 10 0
	Second ...	...	...	...	...	...

1921]

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES OF ROOTS, HAY, STRAW, AND MOSS LITTER,
AT DUNDEE, EDINBURGH, AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

Markets.		Quality.	DECEMBER.									
			Roots.			Hay.		Straw.			Moss Litter.	
			Carrots.	Yellow Turnips.	Swedes.	Rye Grass and Clover.	Timothy.	Wheat.	Barley.	Oat.		
			per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.		per ton. s. d.
Dundee ...	1	...	20 3	35 0	190 0*	...	130 0*	132 0*	150 0*	75 0		
	2	...	...	...	170 0*	...	...	...	...	...
Edinburgh	1	...	...	...	167 0†	...	110 0†	90 0†	110 0†	...
	2	...	...	...	120 0†	...	...	...	...	...
Glasgow ...	1	...	...	30 0	...	...	...	...	...	67 6
	2	...	...	...	...	...	...	...	...	...
JANUARY.												
Dundee ..	1	...	22 3	30 6	183 9*	...	130 0*	130 0*	150 0*	75 0		
	2	...	...	25 0	166 3*	...	...	...	...	...
Edinburgh	1	...	...	...	160 0†	...	105 0†	75 0†	105 0†	...
	2	...	...	...	127 6†	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	65 0
	2	...	...	...	...	...	...	...	...	...
FEBRUARY.												
Dundee ...	1	...	18 9	25 2	172 6*	...	121 11*	121 11*	145 0*	75 0		
	2	...	17 0	21 0	156 3*	...	...	...	...	...
Edinburgh	1	...	...	...	152 6†	...	90 0†	...	86 3†	...
	2	...	...	...	107 6†	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	57 6
	2	...	...	...	...	...	...	...	...	...

* Price for Hay and Straw baled and delivered.

† Price for Hay and Straw delivered loose in town.

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	DECEMBER.		JANUARY.		FEBRUARY.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Linseed Cake -	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Home ...	19 3 0	19 2 0	19 0 0	18 13 2	17 15 0	17 5 0
Foreign ...	18 3 4	..	18 0 0	...	17 3 9	...
Decorticated Cotton						
Cake ...	22 0 0	..	21 15 0	..	...	...
Uncorticated						
Cotton Cake -						
Bombay						
(Home-						
manufactured)	10 13 0	9 18 0	10 15 0	10 0 0	10 15 0	10 0 0
Egyptian						
(Home-						
manufactured)	12 15 0	11 13 9	12 7 6	11 5 0	11 12 6	10 12 6
Paisley Meal ...	13 10 0	...	13 3 4	...	12 6 8	...
Palmnut Kernel						
Cake ...	...	11 0 0	...	...	...	...
Groundnut Cake ...	16 13 0	...	16 7 6	...	...	...
Maize ...	13 2 0	13 6 0	13 1 3	14 2 6	12 6 8	13 5 0
Bean Meal...	21 2 6	...	19 16 8	...	17 18 9	...
Locust Bean Meal	15 6 8	13 0 0	15 5 0	13 0 0	15 0 0	12 15 0
Maize Meal ...	15 2 6	14 8 0	15 17 6	15 5 0	15 0 0	14 0 0
Maize Germ Meal	10 0 0	...	9 16 8	...	9 10 0	...
Maize Gluten Feed	13 10 0	...	...	...	12 10 0	...
Rice Meal...	11 16 8	...	10 3 9	...	9 15 0	15 0 0
Oats ...	14 0 0	11 8 0	13 8 4	12 0 0	13 0 0	10 0 0
Barley (Feeding)...	13 13 4	16 6 0	13 12 6	14 10 0	11 7 6	10 5 0
Malt Culms ...	7 2 0	7 10 0	6 3 9	7 0 0	6 12 6	6 7 6
Distillery Mixed						
Grains						
Dried ...	10 17 0	12 18 0	9 17 6	12 5 0	9 6 3	11 0 0
Wet ...	..	2 0 0	...	...	...	...
Brewers' Grains-						
Dried ...	10 8 0	10 12 0	9 10 0	9 10 0	8 11 3	9 0 0
Wet ...	..	2 0 0	..	...	...	...
Wheat—						
*Middlings (Fine						
Thirds or Parings)	14 10 0	14 10 0	14 10 0	14 10 0	13 0 0	13 10 0
Sharps (Common						
Thirds)...	13 10 0	...	13 10 0	...	12 0 0	...
*Bran (Medium) ...	13 10 0	13 10 0	13 10 0	13 10 0	12 0 0	12 10 0
Bran (Broad) ...	..	...	...	...	...	...
†Feeding Treacle ...	15 10 0	16 10 0	14 10 0	16 0 0	...	15 10 0
Crushed Linseed ...	..	...	...	...	...	...
Fish Meal ...	22 12 0	23 4 0	21 10 0	22 0 0	20 5 0	20 17 6

* Ex-Mill, bags extra. † Nett weight, barrels free.

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The Scottish Journal of Agriculture.

VOL. IV.—No. 3.]

JULY 1921.

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THE FOOD PRODUCTION AND REQUIREMENTS OF SCOTLAND.

PROFESSOR HENDRICK and DR. J. LEWIS ROSEDALE.

THE prosperity and security, indeed the very existence, of a nation depend upon the food supply. Before the Great War the people of Britain worried comparatively little about the security of their food supply, but took it as a matter of course that they would get each day their daily bread, and get it cheaply, and this, although our position is unique among the great nations of the world, in that we have to import half of the food which we consume, and quite three-quarters of the bread-yielding foods which we use, the cereals. This simple faith in the inevitableness of our food supply was somewhat shaken by the war, and the nation did to a certain extent waken up to the importance of home-produced food. It is doubtful, however, whether anything short of a real disaster, such as has been suffered by certain Continental nations and which has brought masses of their people face to face with starvation, will ever really arouse our people to an adequate sense of the importance of a home-produced supply of food, and of the security and strength which a people derive from it.

The greatest and most fundamental requirement of any community is food, and the food-producing industries, and in particular agriculture which produces the raw materials of food, are the foundations on which the prosperity of a state is built. The increase of the home-produced food supply is an increase of the wealth as well as of the security of the nation, and anything which stimulates economic agricultural production is of benefit to the state as a whole, whatever it may be to the individual.

The necessity of increasing the home production of food was generally felt during the war, but that necessity has not passed. In the altered economic conditions of the world we are likely soon to find that it is as important as ever to increase the production of food in this country as also the production of all other essential commodities.

During the war estimates were made in different countries of their food production and requirements. Such an estimate was made for the United Kingdom at the request of the Board of Trade by the Food (War) Committee of the Royal Society under date July 1916 and published as a Command Paper (Cd. 8421) in 1917. The subject was also discussed by Professor T. B. Wood, of

Cambridge University, who was a member of the Royal Society Committee, in a pamphlet, *The National Food Supply in Peace and War*, Cambridge University Press, 1917, which was based upon the estimates made by the Royal Society Committee.

A more elaborate discussion of the food supply and requirements of Germany was made at an earlier period in the war by a very distinguished body of German experts.¹ So promptly did Germany realise the importance of this question that their report was issued already in December 1914—that is, over two years before the publication of the British Committee's Report—edited by Professor Paul Eltzbacher, and an English translation of this important work, edited by Dr S. Russell Wells, appeared in the middle of 1915 under the title, *Germany's Food Supply, Can it Last?*

The Report of the Royal Society Committee and Professor Wood's pamphlet both dealt with the food supply and requirement of the whole United Kingdom, and did not touch upon the production and requirements of the separate sections which compose the Union. It was thought that it would be interesting to many, and a desirable thing in itself to make a separate estimate for Scotland in order to determine approximately how far Scotland is producing sufficient food to feed its own population, and whether it is producing a greater or less proportion of its food than the United Kingdom taken as a whole.

This problem presents some special difficulties in addition to the very great difficulties met with in making estimates for the whole of the United Kingdom, and it should be clearly understood that all estimates of this kind can be regarded only as rough approximations and cannot be expected to exhibit any high degree of accuracy. The special difficulties which arise in making an estimate for Scotland alone are due mainly to the fact that there are no separate returns of exports from and imports into Scotland alone, either from other parts of the United Kingdom or from elsewhere. We do not know how far food produced in Scotland is consumed in Scotland, or sent to other parts of the United Kingdom, or how far, on the other hand, Scotland consumes foods produced or partly produced in other parts of the United Kingdom. We can only calculate how far the food estimated to be produced in Scotland is sufficient to satisfy Scottish requirements if it were consumed there, but in the case of certain kinds of food, such as beef and herrings, we know that as a matter of fact they are largely consumed elsewhere than in Scotland. However, if we are able to produce foods for export, it supplies us with the means of importing other foods in exchange to supply our own needs.

THE FOOD PRODUCTION OF SCOTLAND.

Statistics of the acreage under different crops and of the production per acre are published annually by the Board of Agriculture for Scotland. We have also been supplied by the Board with a table showing the estimated "Total Produce" of the principal crops in Scotland for the years 1911 to 1920. With the

¹ *Die deutsche Volksernährung und der englische Aushungerungsplan* ("Germany's Food and England's Plan to starve her out").

help of these we have estimated the food produced from the principal crops grown in Scotland. Such an estimate is surrounded with difficulties, and there is room for considerable differences of opinion on many points. While the acreages of the different crops grown from year to year can be stated with considerable accuracy, the crops themselves are not weighed, and the weights given in the tables are based on estimates made by a number of skilled and experienced individuals scattered over the country. Such estimates are naturally subject to a certain degree of error no matter how great the skill of the persons who make them. But more formidable difficulties arise when an endeavour is made to estimate how much of each crop is actually available as human food, as in many cases large portions of the crop are used for other purposes, and there are generally no statistics as to the proportion so used.

Cereals.—It may be assumed that, after deducting what is required for seed, all the wheat grown in Scotland is available for milling into flour for use as human food. There is therefore little difficulty so far as wheat is concerned, but the amount of wheat grown in Scotland is small, and home-grown wheat forms only a small part of the total food supply of the country. With wheat we may class the very small amount of rye grown, for though rye is not commonly used as human food in this country it would be available in case of scarcity, and was so used during the war years.

The cases of barley and oats are very different. Much more barley than wheat is grown in Scotland, but it is grown principally to make malt for the distiller or brewer, or as food for stock. After deducting what is required for seed and what is estimated to be used by the distiller and brewer and as food for stock, we arrived at the conclusion that not more than one-tenth of the crop is normally available for milling as human food. We have therefore in our calculations assumed that only one-tenth of the barley produced is used in preparing human food. What is used by the distiller and brewer forms, however, a potential store of human food which could be and no doubt would be drawn upon in an emergency, as was to some extent the case during the late war.

The cereal grown in much the largest quantity in Scotland is oats, and in the oat crop we have by far the greatest store of cereal food produced in the country. At one time oats no doubt formed the principal food of the inhabitants, and even at the present day oatmeal forms a very important part of the food of agricultural labourers in large districts in Scotland. The greater part of the urban population, however, now uses comparatively little oatmeal, and even in the country districts wheaten bread has largely replaced oatcakes. There are no statistics to show how much of the oat crop is made into oatmeal and used as human food. Oats form, however, an important and generally used food for horses, and there are in Scotland about 250,000 horses. We have estimated that these consume two million quarters of oats, which, together with what is required for seed, accounts for more than half the oats produced in the country. In addition a considerable part of the crop is commonly fed to cattle. The amount which is so fed varies considerably from year to year, as when oats are cheap or other feeding stuffs are dear, or when the crop is damaged by

weather conditions, more is used for stock than when the price of oats is relatively high, or when the crop is harvested in good condition. Any estimate of the amount available for human food can therefore be only a comparatively crude one. We have arrived at the conclusion that about nine million bushels are normally used for the production of oatmeal. It is obvious that this quantity might be increased in case of an emergency.

Potatoes.—Another very important food crop is the potato. In this case the crop is produced mainly for use as human food. Scotland has an important trade in seed potatoes, but what is used for seed generally consists of smaller tubers which are not so suitable for sale as human food. In this case, therefore, we have made deductions only for seed and for waste, and have assumed that the whole of the rest of the crop is used as human food.

In addition to the acreage under potatoes which appears in the Agricultural Returns a considerable quantity of potatoes is grown for use as human food on allotments and in gardens. In the case of allotments, which have increased so greatly during recent years, potatoes are the principal crop grown. The crop grown in gardens and allotments is on the average considerably heavier per acre than that obtained by field cultivation. We have obtained from the Board of Agriculture statistics as to the acreage under allotments, but it is not possible to obtain any corresponding figures for gardens. After considering the whole question we have assumed that 25,000 tons per annum of potatoes are produced for human food in allotments and gardens not included in the Agricultural Returns. This is a conservative estimate and it is possible that the actual production considerably exceeds this figure.

Vegetables and Fruit.—Certain statistics concerning vegetables are to be found in the annual Agricultural Returns, but these relate more to crops of turnips, cabbages, etc., grown on farms as food for stock than to those grown for human food. Vegetables grown as human food are even on farms produced largely in the gardens of the farm-house and of the farm labourers, and are not included in the Agricultural Returns. In the case of towns they are produced mainly in market gardens, but a considerable supply is also produced in gardens and allotments for which we have no statistics. We were able to obtain some information from the data collected for the census of agricultural production in Scotland in 1913, but to a large extent we have had to make estimates based on little reliable information. We have kept our estimates, in these circumstances, on the conservative side, and it is not improbable that the actual amounts of vegetables produced in Scotland exceed them to a greater or less extent. In any case the total amount of food produced in the form of all other vegetables than potatoes is comparatively small.

Similar considerations apply in the case of fruit. Scotland produces little tree fruit, and although considerable amounts of small fruit are grown, in the aggregate these form only a small part of the food supply, though, like vegetables, they form a not unimportant one from certain points of view.

Meat.—The Agricultural Statistics give an annual statement of the numbers of live stock in Scotland on 4th June of each year.

With the help of this statement we are able to estimate the annual crop of beef, mutton and pork which will probably be produced in each year. The figures so obtained we were able to check by reference to certain figures which have been published, and which are based upon the data collected during 1918 and 1919 by the Live Stock Department of the Ministry of Food.¹

During the later years of the war conditions were abnormal. Though the number of cattle in the country did not decrease, the carcase weight did. In the case of sheep both the numbers and the carcase weights decreased during the war. The actual figures obtained for beef and mutton production by the Ministry of Food during 1918-1919 cannot be taken as the normal production of an average year in peace time, but they afforded a useful check on our figures.

In making our estimates we had difficulty in deciding what average carcase weight we should take for all the cattle and sheep respectively, slaughtered in Scotland. We finally decided to keep on the conservative side, and took the average weight of carcase sold as food as 5 cwts. in the case of cattle, and as 50 lbs. in the case of sheep. Cattle include animals of all ages slaughtered for food, and include cows as well as bullocks and heifers. Sheep include lambs. An estimate in this way agrees well with the figures obtained by the Ministry of Food in 1918-1919, after adding the amount by which it is estimated that the average carcase weights fell in these years below the normal owing to lack of feeding stuffs.

Even if our estimate errs by being too low there is a good reason why we should keep it low. Much of the beef killed in Scotland has not been entirely produced in the country. Great numbers of store cattle are imported from Ireland, and are only fattened in Scotland. A considerable part of the meat obtained from such animals was really produced in Ireland. Similarly in the case of milk cows, large numbers are imported from England and Ireland, and are merely kept for a season or two in Scotland, and then fattened off for the butcher; a considerable part of the meat of these should be reckoned as produced in England or Ireland. This difficulty does not arise in the case of sheep, of which Scotland has a very large number. These are generally bred and fed entirely in Scotland. The number of pigs kept in Scotland is small, and the total amount of pig meat produced is very small compared with the production of beef and mutton.

Fish.—The figures for the production of fish were obtained mainly from the Statistical Abstract for the United Kingdom from 1905 to 1909 published by the Statistical Department of the Board of Trade (Cd. 1246), but in part from the Report of the Fishery Board for 1919.

In making our estimate of the average production of fish we came to the conclusion that we ought to neglect the war years, as the production decreased enormously during these years owing to war causes. Our estimate therefore is based on the quantities of

¹ "Variations in the numbers of Live Stock and in the Production of Meat in the United Kingdom during the War." By J. B. Guild, M.B.E., M.A., *Jour. Roy. Statistical Soc.*, new series, vol. lxxviii., 533-571. 1920.

edible fish caught during the ten years preceding the outbreak of war, 1905 to 1914.

Compared with its population Scotland maintains a very large fishing fleet, and produces a very great quantity of fish. It is, however, well known that a large part of the fish landed in Scotland is exported and consumed elsewhere. Great quantities of herrings, for instance, are usually salted and sent to Baltic ports, while large amounts are sent as fresh or kippered herrings to England. Similarly in the case of white fish a large part is sent fresh to the English markets, and a part is salted and exported, chiefly to foreign countries. We have divided fish for the purposes of the computation of food value into three classes: (1) Herrings, with which we include the somewhat similar mackerel. Both of these are fatty fish, and contain a large percentage of fat in their edible parts. The amount of mackerel landed is small compared with the amount of herring. (2) White fish, such as cod, haddock, ling, the various flat fish, etc. These contain very little fat in their edible parts. (3) Salmon, with which we include sea trout and trout.

Poultry and Game.—Statistics as to the annual production of fowls were obtained from the Census of Agricultural Production in Scotland, 1913. Fowls, ducks, geese and turkeys are all included, but the fowls form by far the largest item as they are nearly fifteen times as numerous as all the others put together. From the same statistics information was obtained as to the number of eggs produced and sold annually in Scotland.

There are no means known to us for accurately estimating the production of game in Scotland. There are, however, great areas of sporting land which yield a considerable annual harvest of venison, hares and game birds, while rabbits abound to far too great an extent nearly all over the country. In stating the production of edible food in the form of game at 5000 tons per annum we are not erring on the side of liberality. It is quite possible that rabbits alone would give that figure.

Dairy Produce.—The figures which we have taken for the production of dairy produce in Scotland are based mainly on the tables given in the returns of the Census of Agricultural Production in Scotland, 1913, but they have been checked, wherever possible, by estimates based on the annual Agricultural Returns.

In the census returns the total amount of milk produced in the twelve months ending 4th June 1913 is given, and also a statement of the amount sold, as whole milk, as cream, as skim milk, as butter, and as cheese. These figures rendered our task easy in the case of dairy produce. In estimating the amount of milk consumed allowance was made for the fact that the bulk of the agricultural population do not require to purchase milk. Farmers and small-holders generally produce it themselves, while agricultural labourers customarily receive a daily allowance of milk as part of their remuneration.

Honey.—Honey forms only a small item in the food supply of the country, but the production might no doubt be greatly increased without prejudicing any other form of food production. We are indebted to the report for 1920 of the Scottish Bee-keepers' Association for the estimate that the number of hives in

Scotland is not less than 40,000, and to Mr John Anderson, B.Sc., Lecturer in Bee-keeping, North of Scotland College of Agriculture, for the estimate that the honey production per hive averages 30 lbs. per annum. This gives a total production of 1,200,000 lbs. per annum.

THE COMPOSITION AND USES OF FOOD.

In order to estimate the nutritional values of the foods produced in the country we require next to know their average analyses, so far at any rate as relates to their principal constituents. The main constituents, the percentages of which we require to know for the present purpose, are the proteins, fats and carbohydrates. The percentage of each of these in each of the foods considered is given in the Table on p. 245. Our analyses have been taken from various sources and differ to some extent from those used by the Royal Society Committee, though unless we had some good reason to the contrary, we used the analysis given by that Committee in their Report (Appendix I, A), or the analysis given by the late Professor W. H. Thomson of Dublin in the same report (Appendix I, B). These analyses are drawn mainly from American sources. We endeavoured to correct them in the light of analyses of British food products, and, when possible, of Scottish food products. One of us has had considerable experience of the analysis of local food products, and we had also the advantage of access to a large number of analyses of foods made in quite recent years by Dr R. H. A. Plimmer, head of the Bio-Chemical Department of the Rowett Institute for Research in Animal Nutrition.

There are two main reasons why an animal must have food :

- (1) it requires material to build up its body, or in the case of an adult animal, to repair the constant waste which is taking place ;
- (2) it requires to consume food as a source of energy for the internal and external work of the body and to maintain the body temperature. Stated in another way, the two main uses of food to the animal are as building material for the body, and as fuel to keep the animal machine running, and to enable it to do work.

The chief building material for the animal body is protein, and it is therefore customary to consider the amount of protein present in the food, as giving a measure of the value of the food for building or maintaining the animal body, though it must not be supposed that the matter is so simple as here stated, or that there are no other factors which enter into the complicated question of animal growth and repair of tissue. On the other hand, the fuel value of the food is stated in terms of calories,¹ or units of heat, and the estimates made during the war by the German Committee, and by the Royal Society Committee of the food production and requirements of Germany and the United Kingdom respectively, were made in terms of protein and calories. We cannot compare foods together merely by weight, for dry foods like flour and oatmeal are not comparable weight for weight with moist foods like milk and potatoes. Nor can we compare them together by reducing them all to terms of so much dry matter, for the dry material of one food

¹ The large calorie is used throughout—*i.e.* the amount of heat required to raise 1 kilogram of water 1° centigrade.

is of very different value from the dry material of another. Each of the three important constituents of foods already mentioned, proteins, fats and carbohydrates, has a different value in nutrition, and they cannot therefore be merely added together. We must use at least two different units in estimating food value: one for the building material of the body, and this, as already stated, we take in terms of protein, and the other for the fuel, and this we estimate in terms of calories.

In addition to its value for building purposes protein has a fuel value, and ultimately it is used in the body as fuel. On the other hand, the value of fats and carbohydrates is measured by their fuel value only. For fuel purposes fat has the highest value, and is about $2\frac{1}{2}$ times as valuable as carbohydrates. Carbohydrates and protein have approximately equal fuel values.

In the Table on p. 245 we have stated for each food the amount in tons, as well as the percentage of protein, fat and carbohydrate which it yields, and by adding these together for all the foods we arrive at the supply of protein, fat and carbohydrate produced in Scotland for human food purposes. Each pound of carbohydrate and each pound of protein is approximately equal to 1860 calories, and each pound of fat is approximately equal to 4218 calories. This means that when a pound of fat is consumed and oxydised in the animal system, it produces energy equal to 4218 calories, and similarly with carbohydrates and proteins which each produce about 1860 calories per lb. when oxydised in the animal body. Each ton of fat oxydised by the animal has an energy value of about 9,448,200 calories, and each ton of protein or carbohydrate similarly oxydised has an energy value of 4,166,400 calories.

The Table.—In the Table showing the “Estimated Quantities of Human Foodstuffs produced in Scotland,” the results of our inquiries and estimates are summarised and tabulated.

In the first column of figures “Nett Human Food” is stated in tons. By nett human food we mean the foodstuffs after deducting those parts which are necessarily or customarily rejected and allowed to go to waste or used for purposes other than human food. Thus in the case of cereals, the Table does not give the total weight of the cereal grain, but the weight of wheat flour or oatmeal, as the case may be, which is estimated to be used as human food. In the case of wheat grain there is in addition to the flour a considerable weight of so-called “offal,” such as bran, sharps, etc., which is used almost entirely as food for stock.

In the case of potatoes the total weight of the crop used for food has not been taken, but a deduction made for the skins and adherent dirt, which go to waste or are used as pig food. In the case of herrings we deducted 40 per cent. of the total weight to allow for the heads, guts and other parts which are not eaten, but which are, to a certain extent, used to make fish manure.

The analyses which we have used, and which are shown in the next three columns of figures, numbered 3, 4 and 5, in the Table, are intended to represent the analysis of the “nett human food” shown in column 2. Thus, in the case of herrings or of salmon the analysis is not that of the whole fish, but is intended to represent

ESTIMATED QUANTITIES OF HUMAN FOODSTUFFS PRODUCED IN SCOTLAND.

Nett Human Food.	Analysis.			Quantity.			Energy Value.
	Protein.			Carbohydrate.			
	Per cent.	Fat.	Carbohydrate.	Protein.	Fat.	Carbohydrate.	
	Per cent.	Per cent.	Per cent.	Tons.	Tons.	Tons.	Millions of Calories.
CEREALS—							
Wheat Flour ...	51,913	11.4	1	75	5,918	519	38,935
Barley ..	10,000	10.5	1	72.8	1,050	100	7,280
Oatmeal ...	101,230	14	8.5	67	14,172	8,605	67,824
Rye Flour ...	3,604	11	1	75	396	36	2,703
VEGETABLES AND FRUIT—							
Potatoes ...	691,400	2	0.1	20	13,828	691	138,280
Cabbage, etc. ...	24,093	1.6	0.4	4.2	385	96	1,011
Green Peas, etc. ...	1,000	5	0.5	15	50	5	150
Onions ...	1,325	0.5		5.5	7	...	73
Rhubarb ...	13,860	0.5		3	69	...	416
Carrots ...	4,800	1		9.6	48	...	461
Small Fruit ...	12,208	1		6.5	122	...	793
MEAT—							
Beef ...	87,000	14.5	22.5		12,615	19,575	237,507
Mutton ...	63,000	13.5	25		8,505	15,750	184,24
Pork, etc. ...	15,600	10	40		1,560	6,240	65,456
FISH—							
Herrings and Mackerel	155,404	11	10		17,094	15,540	218,945
White Fish ...	74,931	15			11,105	...	46,267
Salmon, etc. ...	1,300	17	15	...	221	195	2,763
POULTRY AND GAME—							
Poultry ...	1,520	20	8		304	121	2,409
Eggs ...	7,356	11.9	9.3		876	684	10,112
Game ...	5,000	20	8		1,000	400	7,945
DAIRY PRODUCE—							
Whole Milk ...	460,700	3.3	4	5	15,203	18,428	333,426
Cream ...	6,696	2.5	20	3.5	167	1,339	14,321
Butter ...	3,125	1	85		31	2,656	25,223
Cheese ...	8,885	2.5	30	2.4	2,221	2,665	35,322
Skim Milk ...	53,571	3.5	0.3	5	1,875	160	20,485
HONEY ...	535	1		75	5	...	1,692
GRAND TOTAL	...	...	...	...	108,827	93,805	2,524,988

the average composition of the flesh of the fish which is used as human food. The analysis in each case takes account only of the three important constituents—protein, fat and carbohydrate.

In the next three columns, 6, 7 and 8, the weights of protein, fat and carbohydrate are shown calculated as tons in the case of each food. These figures are derived from those contained in columns 2 to 4, and their accuracy therefore necessarily depends on the accuracy of the figures in columns 2 to 4. Finally in column 9 the total energy value of the protein, fat and carbohydrate, stated in columns 6 to 8, is given in terms of millions of calories.

A large amount of home-produced foodstuff, especially barley, is used in making alcoholic beverages, and such beverages are capable of yielding a certain amount of energy when oxydised in the human body. The German Committee included alcoholic beverages in their tables, but the Royal Society Committee did not do so. We decided to follow the example of the Royal Society Committee, and avoid the very debateable subject of the food value of such beverages. They are therefore left out of the Table. No doubt the materials which are used in the preparation of alcoholic liquids could be used to a large extent in the direct preparation of human foods capable of yielding a large supply of protein and calories.

THE POPULATION AND FOOD REQUIREMENTS OF SCOTLAND.

The Census of 1911 gives the population of Scotland as 4,760,904 persons. It is estimated that in the middle of 1920 the population was 4,864,396. Of these it is estimated that 1,570,365 were children up to 15 years of age, while 1,723,127 were females, and 1,570,904 males above the age of 15 years. If we divide the food produced at home equally among the whole population, it will allow a daily ration of 62 grams of protein, 54 grams of fat, and 163 grams of carbohydrate per person per day. There are approximately 28½ grams in an ounce, so this ration would be equal to a little more than 2 ounces of protein, a little less than 2 ounces of fat, and about 5½ ounces of carbohydrate. We require next to consider how far these quantities are sufficient for the needs of an average individual.

The food requirements of individuals vary greatly according to their age, size and weight, and according to the nature and amount of the work which they do. A child requires less than a grown man, though per pound of his weight he requires more. An adult of sedentary habit requires less than an adult of similar weight and age engaged in heavy manual labour. Much investigation has been made by physiologists in Germany, America, Britain and other countries into the food requirements of different classes of persons, and there are considerable differences of opinion on many points.

The Royal Society Committee stated their conclusion on this question as follows:—

“A full consideration of the dietary requirements of a nation for the most part engaged in active work has convinced the

Committee that these requirements cannot be satisfactorily met on a less supply in the food as purchased than 100 grams protein, 100 grams fat, 500 grams carbohydrate, equal approximately to 3400 calories per 'Man' per day, a 'Man' being an average workman doing an average day's work. The Committee have adopted this as their minimum standard. It must be remembered that fats and carbohydrates are interchangeable to a limited extent." This is in agreement with the views which are generally held on this subject by physiologists, though some place the protein requirements rather higher, but, on the other hand, there are others who consider that the average man can live quite well with much less than 100 grams of protein per day. Similarly there is some difference of opinion as to the daily requirement of a "man" in calories, but 3400 calories per day represents what is generally considered sufficient for a man doing average work.

The German Committee, which included Rubner, one of the greatest authorities on this subject, also considered this question very fully, and came to the decision that "a grown man can manage very well on an average of 70 grams of digestible protein without harm to his body." They decided, however, that taking other matters than mere physiological requirement into account it would be advisable to reckon 80 grams of "digestible protein" per head per day.

The estimate of the British committee is not quite comparable with that of the German committee, for the Germans estimated *digestible* protein, and the British protein *as purchased*. A little of the protein of the food as purchased is generally wasted. Part of it may go as scraps and leavings into the pig's pail, or the ash bucket. Of that which is actually eaten a small part is excreted again without being digested. If allowance is made for these portions which are not actually used in the human body there is no great difference between the German 80 grams of "digestible protein" and the British 100 grams of "protein as purchased." Our estimates like those of the Royal Society Committee refer not to "digestible" protein, but to protein as purchased, and we propose to assume that the average man should have a daily allowance of 100 grams of such protein.

Somewhat similar considerations apply to the calorie estimates of the British and German committees. The Royal Society Committee arrived at the conclusion stated above, that the average daily energy requirement per man is 3400 calories, derived from 100 grams of fat and 500 grams of carbohydrate with the 100 grams of protein already decided upon. The German Committee, on the other hand, decided, "On the whole we should not make too low an estimate if we put the food requirements of a healthy, full-grown man at an average of 3000 calories." As in the case of protein estimates, the German estimate refers to "digestible" food and the British to food "as purchased." If we take into account that there is always some waste, especially of fat, and that a little food escapes digestion, there is very little difference between the German and British estimates, and in this case also we propose to adopt the estimate of the Royal Society Committee that an average man requires 3400 calories per day,

derived from 100 grams protein, 100 grams fat and 500 grams carbohydrate, and that fats and carbohydrates are interchangeable to a limited extent.

The estimates given above of the British and German committees refer to the requirements of an average man, or, in the language of the British committee, of "an average workman doing an average day's work." It has been already indicated that the requirements of an adult male may vary considerably according to circumstances. An individual of large size and weight requires more protein and more calories from his food than a smaller individual. The amount of food, and especially the amount of energy it is capable of yielding, requires to be increased with the amount of physical work which an individual is required to do. Though a brain worker may be doing a great deal of work of the most valuable kind, if he is sitting still at his work he does not require so abundant a diet as a manual worker who is doing little or no brain work, but who is doing heavy manual work.

It is practically impossible to arrive at the ideal diet in protein, fat, carbohydrate and calories for all the various men in the community as that varies for each individual according to the whole circumstances of the case, but the requirements stated above are in round figures those of a man of average size who is engaged neither in specially heavy physical work nor in specially light work.

Women are on the average lighter in weight than men, and though, like men, the amount of physical work they do varies greatly with different individuals, on the average they are not called upon to expend so much energy upon physical work as men. In modern civilised communities women are generally engaged on light or moderate work. For these reasons it is generally held that their food requirements are lower than those of men, and this is confirmed by such statistics of the actual consumption of food by men and women respectively as are available. The consensus of opinion among experts in this subject places the average food requirement of women at 80 per cent. of that of men. In other words, the average woman requires 0.8 of the diet in protein, fat, carbohydrate and calories of the average man, or 100 women require as much food as 80 men. This is the proportion which the Royal Society Committee adopted, and we have adopted the same.

In the case of children the average requirement varies with the age of the child, and till the age of puberty is reached it may be assumed that the requirements of boys and girls are similar. In proportion to their weight children require rather more food than adults, for they are increasing the size of their bodies, and though not engaged in what is called work, it is natural and right that they should be active and develop their bodies by taking a large amount of physical exercise. It is especially with the young that a liberal diet is needed if they are to grow up strong and healthy and develop their bodies as it is desirable that they should do. Taking everything into consideration, we have come to the conclusion that we ought to allow for the average child up to the age of 15 years 60 per cent. of the food of an average man. In other words, we

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assume that the food requirement of a child up to 15 years of age is 0·6 that of a man, or that 100 children require as much food as 60 men. This is rather more liberal than the allowances made to children by the Royal Society Committee.

We are now in a position to calculate the whole population of Scotland in terms of "men" as follows :—

1,570,904 males above 15 years of age	= 1,570,904 men.
1,723,127 females " " " " " × 0·8	= 1,378,501 "
1,570,365 children up to 15 years of age × 0·6	= 942,219 "
4,864,396 individuals	= 3,891,624 men.

We arrive at almost the same figure for the total man value for the population if we assume that the average individual out of the whole population is equal to 0·8 of a "man" or that each 100 individuals require as much food as 80 men. The method adopted by the Royal Society Committee for the United Kingdom leads to the conclusion that "100 men, women and children of a mixed population correspond to 77 units or men."

If then we divide the food shown in the Table into rations per day for 3,891,624 men, it will be found that it amounts to 78 grams of protein, 67 grams of fat, 104 grams of carbohydrate, and 1776 calories per "man" per day. This is far short of the average requirement of 100 grams of protein, 100 grams of fat, 500 grams of carbohydrate, and 3400 calories per "man" per day, and it is therefore evident that even if all the food shown in the Table were consumed at home, it would still fall far short of the requirements of the population, especially in carbohydrates and calories.

The estimates of the Royal Society Committee showed that for the five years before the war, 1909-1913, the quantities of food-stuffs available, including both home-produced and imported food-stuffs, were sufficient to yield per day :

	Protein	Fat.	Carbohydrate.	Calories.
Per head .	87 grams	100 grams	440 grams	3091
Per "Man" .	113 "	130 "	571 "	4009

The conclusion is therefore drawn that "The supply has not only met our requirements in the past, but has also provided a margin of waste. Calculated on the *minimal* physiological standard, there has been either wasted or consumed in excess of requirements, of protein 11 to 14 per cent., of fats, 25 to 30 per cent., of carbohydrates 10 to 14 per cent."

Though the diet of the people of Scotland still differs to some extent from that of the people of England, the differences which once existed have under modern conditions largely disappeared, and while possibly on the average the people are slightly more frugal, they are, generally speaking, as well nourished as the inhabitants of England. It is probable, therefore, that in Scotland, as in the United Kingdom generally, there was before the war, and still is, a margin of waste. If we assume for Scotland the figures found for the United Kingdom by the Royal Society Committee, we may summarise the position as follows :—

		<i>Protein.</i>	<i>Fat.</i>	<i>Carbohydrate.</i>	<i>Calories.</i>
Total Food Supply (Home-	Per Head	87	100	440	3091
produced and Imported)	Per Man	113	130	571	4009
Minimum Food Requirement	Per Man	100	100	500	3400
Food produced in Scotland	Per Head	62	54	163	1420
	Per Man	78	67	204	1776

It is not claimed that the figures which we have worked out for Scotland possess any high degree of accuracy. As has been explained above, they amount only to a rough approximation, but this is sufficient for the purpose, and shows that in Scotland, as in the United Kingdom generally, a very large part of the food necessary for the maintenance of the population has to be imported. The estimates of the Royal Society Committee showed that for the United Kingdom 58.4 grams of the protein available for food per man per day was home-produced, and 54.6 grams was imported. Similarly of the fat, 69.6 grams was home-produced, and 60.1 grams was imported. In the case of fat the home-produced figure given above for Scotland, 67 grams, is nearly the same as that found by the Royal Society Committee for the whole country, while in the case of protein Scotland seems to be producing at home a larger proportion per man per day, 78 grams, than is produced by the United Kingdom generally, 58 grams. The position is, however, not quite so favourable as at first sight appears.

The Royal Society estimates refer to foodstuffs, home-produced and imported, actually available for consumption as human food in the United Kingdom. But the estimates which we have made for Scotland refer to foodstuffs which, though produced in Scotland, are known not to be consumed in their entirety in Scotland. There are no means of ascertaining exactly what proportion of the beef, mutton and fish produced in Scotland is consumed in Scotland, as separate returns are not kept of imports and exports between Scotland and other parts of the United Kingdom.

The foodstuffs produced in Scotland which are known to be largely exported from Scotland and consumed elsewhere are, generally speaking, rich in protein and fat. Of these the principal is fish. Reference to the Table will show that a larger weight of protein occurs under herrings than under any other single heading in the Table. A very large amount of fat is also included under herrings, but still larger amounts are found under beef, whole milk and mutton, herrings coming only fourth for fat production. In quantity of protein, however, herrings come first, and surpass even whole milk, oatmeal and beef. In white fish also a great deal of protein is contained. Herrings are very largely exported, and therefore a large part of the protein and fat shown under this heading are not available for consumption in Scotland. White fish are not exported to quite so great an extent, but a deduction from the supply of protein shown in the Table must be made in their case also.

Other foods rich in protein and fat which are largely exported from Scotland are beef and mutton. On their account also an appreciable deduction would have to be made from the protein

and fat available per "man" per day from foods produced in Scotland. If all these deductions are taken into account it is probable that no larger proportion of the protein consumed in Scotland is home-produced than in the case of the United Kingdom generally, and possibly the proportion of fat which is home-produced is smaller than the average for the United Kingdom.

In the case of carbohydrate the Royal Society Committee estimated that the home production per "man" per day was 191·8 grams, while our estimate for Scotland is 204 grams. The foods produced in Scotland which supply the greatest amounts of carbohydrate for human consumption—potatoes, oats, wheat and whole milk—are also consumed mainly in Scotland, and comparatively little is exported for consumption elsewhere. It will be noticed, however, that in the cases both of the United Kingdom and of Scotland, by far the largest part of the carbohydrate consumed is imported. If the average consumption is 571 grams per man per day, nearly two-thirds of this must be imported. The two articles in which the main import of carbohydrate takes place, whether we regard only Scotland or the whole of the United Kingdom, are wheat and sugar. Wheat forms our principal source of bread, and in Scotland, even more than England, we depend on foreign supplies for our wheat. Sugar is a carbohydrate food, and supplies a considerable proportion, about 20 per cent., of the total carbohydrate we consume. It is entirely imported from abroad, and there seems little likelihood that any appreciable part of our supply will ever be produced in Scotland, except in so far as honey may be looked upon as part of the sugar supply.

The general conclusion of the whole discussion is that less than half of the human food consumed in Scotland is produced in Scotland. There seems little doubt that agricultural production in Scotland, as in the rest of the United Kingdom, could be increased considerably (*a*) by better farming, and (*b*) by bringing more land under cultivation. It is not our intention to discuss this subject at present, or how far it might be expedient or profitable to increase agricultural production, but it may be pointed out that even if agricultural production in Scotland were as greatly increased as it might be, this would not necessarily increase the home-produced supply of human food to any great extent.

The principal food which we import is wheat, but even if cereal production were greatly increased in Scotland it is probable that the increase would be chiefly in oats, as generally speaking, it pays the Scottish farmer better to grow oats than to grow wheat. But if the supply of home-grown oats were increased it is very unlikely that the consumption of oatmeal as human food would be increased. The tendency is for the mass of the population to consume wheaten bread, and to cease using oatmeal as the principal cereal foodstuff, and although it is likely that porridge and oatcakes will continue to be consumed to a limited extent by large numbers of Scots people, it is very improbable that anything short of compelling necessity will ever induce them to return to oatmeal and barley meal as the staple articles of diet. Wheat will probably

continue to be in Scotland, as in England, the staple breadstuff, even if we have to import the greater part of the wheat.

While it is not likely that we shall ever be able to grow in Scotland all the wheat we require, the production of wheat might be considerably increased if there were sufficient inducement to grow it. Aberdeenshire is generally held to be a county unsuitable for the growth of wheat, and practically no wheat is grown in this the largest agricultural county in Scotland. Trials made at Craibstone, the experimental farm of the North of Scotland College of Agriculture, for some years past, have shown that large crops of wheat can be grown and ripened in Aberdeenshire provided the crop is sown sufficiently early. Similarly Mr Cruickshank, Port Erroll, has grown wheat every season for several years past, and his crop has almost invariably been a good one. There is no reason therefore why wheat should not be grown in the lower districts of Aberdeenshire, provided the price were sufficient to make it worth while.

The production of other crops, such as potatoes, might also be increased, but as potatoes sufficient for the requirements of the population are at present grown in Scotland, there is not much inducement to increase the production, except in the case of seed potatoes for the English market.

Improvements in agricultural production in Scotland, therefore, are not likely to take the direction of greatly increasing the crops grown directly for human food. Certain of the smaller lines, such perhaps as certain vegetables and fruits, might be considerably increased if proper means were taken by men of initiative, enterprise and business capacity. We have an example of this in what has been done with raspberries in certain parts of Scotland. The chief direction which increased agricultural production might take in Scotland is towards increased production of food for stock, so as to increase the capacity of the country for maintaining stock and producing beef, mutton and dairy produce. Probably such increased production might be brought about by departing from tradition and adopting cheaper methods and more suitable rotations. The production of silage instead of turnips on heavy lands and in wet climates is an improvement which some have found very successful, but the discussion of such methods of increasing production would take us beyond the scope of the present paper.

METEOROLOGY AND AGRICULTURE.

LT.-COL. E. GOLD, D.S.O., F.R.S.

Assistant Director, Fore-cast Service, Meteorological Office, Air Ministry.

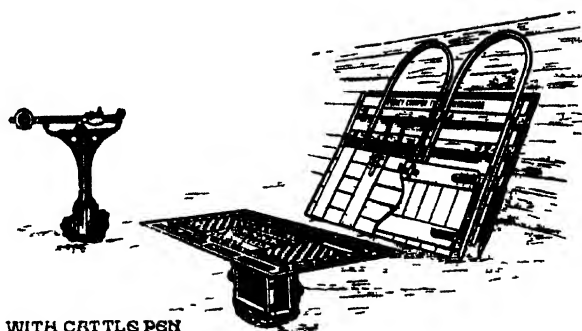
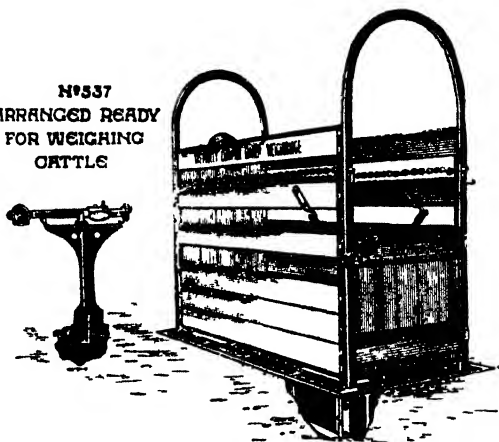
I

As I write, on 2nd June 1921, the sun shines from a cloudless sky and reminds me that yesterday morning notifications were issued by the Meteorological Office of the commencement of a spell of fine weather. I know, therefore, that I cannot count on my garden getting any showers for the next few days, and I shall act accord-

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ingly, watering young plants to get them firmly established, and hoeing weeds in the assurance that the dry weather and sunshine will complete my work. I have no difficulty in deciding what is the right thing to do ; there is no need to worry or to be prepared to accept with stoical indifference a change of weather, undoing my work or proving my precautions to have been unnecessary. Through the patient research and careful organisation of meteorological services in all the countries of Europe that knowledge of the future has been made possible, and it is now available for every British farmer, gardener or merchant who wants it.

But spells of fair weather can neither be made nor foretold to order, and there are long periods when no real spell comes. In fact British meteorology is, broadly speaking, a thing of patches in time—one day fine, another day wet, another gloomy and cold ; just as British agriculture is a thing of patches in space—one field roots, another field corn, another pasture. This makes it impossible that the weather at any one time shall be the *optimum* (or best) for all crops and operations. Further, even if a meteorologist could describe beforehand the exact details of the weather for each day of the year, the farmer could not foretell the exact details of development of his crops nor the resulting harvest : as we shall see below, however, something has been done in the past twenty years to remedy this latter defect, and to find the precise effect upon crops of the weather at different periods of the year. Investigations in different countries show that the broader features of seasonal weather as well as the details of day-to-day weather have a real significance in agricultural operations : and as it is easier to appreciate and to apply forecasts for short periods, this aspect of the subject will be considered first.

II

Forecasts are made nowadays in the following way. Reports are collected two, three or four times a day from different places scattered over a wide area extending from Iceland to Madeira, and from Spitzbergen to Cairo. The chaos in Russia prevents for the time being an adequate representation of Eastern Europe. One or two reports are also received almost daily from some ship in the Atlantic to the West of Ireland, and as sailors gain further knowledge of the application of synoptic meteorology in their calling these reports may be expected to increase.

The reports collected in this way give information of the height of the barometer (which measures the pressure of the atmosphere) and the way in which the barometer has been changing, the reading of the thermometer, the direction and speed of the wind, the visibility (or clearness of the air), the humidity (or dampness of the air), the cloud and its height, and a brief description of what the weather has been in the interval of time between reports. By an ingenious utilisation of figures, the whole of the information is telegraphed in four groups, each group consisting of five figures. The information collected in this way is entered upon charts, and maps similar to the illustration on p. 257 are drawn.

These maps are examined (a) in connection with the immedi-

ately preceding maps to see what changes have occurred; (b) in connection with maps for the same time of year in preceding years to see what changes followed on those occasions when the maps had the same characteristic features as the maps from which the forecasts are being prepared.

Further the winds in the upper air at a number of places (obtained by watching small free balloons with a theodolite), sometimes for heights as great as 30,000 feet, and temperatures up to 15,000 or 20,000 feet (obtained from aeroplanes), are also taken into consideration, as well as the physical developments to be expected from the direction, strength and temperature of the different currents shown by the observations reported. For example, yesterday morning observations from Ireland showed that a current, 25° F. warmer at 10,000 feet altitude than the air which it was replacing, was spreading over these islands, thus removing the risk of hail and thunder showers, and helping the establishment of fair and warmer weather.

The first principle in forecasting is that weather travels, so that usually a region will experience the weather which is travelling towards it: the second principle is that hills and mountains modify the weather in their locality by forcing the air travelling towards them to rise, whereby it is cooled by expansion, and tends therefore to form cloud and rain if it is damp to begin with: the third principle is that cold surface air tends to cut underneath warmer air, lifting it up and again producing cloud and rain if the dampness and lift are sufficient: the fourth principle is that cold air moving over land or sea, where it becomes unduly warmed at the surface, is set into a vertical circulation, with the production of cloud and showers.

It is possible to forecast with reasonable accuracy and confidence for a period of twenty-four hours ahead in nine cases out of ten. But occasionally the charts give no clear indication of what future developments will be, and the forecaster has then to indicate the relative uncertainty of his prediction by a careful choice of language. The plan of indicating the degree of certainty of the forecast by the use of numbers or letters has attractions, but it adds usually to the length of the messages: a forecast deals with a number of elements and their variation over a period of twenty-four hours, and the degree of certainty of the forecast varies for the different elements. On the whole the degree of certainty is considerably higher for the south and east of England than for other parts of the British Isles.

III

One of the greatest difficulties is to provide adequate means of distributing the information available to the professional meteorologist. In France the forecasts are telegraphed to all post offices, where they are exhibited for the information of the public: a similar plan was followed in Austria before the war. In the United States the forecasts are telegraphed to about one thousand six hundred distributing points, whence they are disseminated by telegraph, mail and telephone: they are said to be available to 5,500,000 telephone subscribers within an hour of the time of issue.

Mr H. Mellish emphasised the superiority of the United States in this matter of distribution of forecasts in an address to the Royal Meteorological Society in 1910, and he added that British farmers have much to learn from their American colleagues in the use of meteorological information, illustrating his thesis by quoting a case where the ordinary business of a town was suspended and the schools closed, while the whole population turned out to save the apple crop from an approaching frost of which warning had been received.

In the British Isles forecasts and other meteorological information are supplied free of charge to the newspapers. Some newspapers publish the information fully; others give only a brief extract; while others employ "improvers" to better or extend the official predictions. The reports in the morning newspapers are about twelve hours old before they are read; consequently they have the disadvantage that the period which can be forecasted most accurately has already passed; and later information is actually available then at headquarters which would permit the forecast to be revised and made applicable to a longer period ahead. Nevertheless these forecasts in the Press can be of much service, owing to their relatively quick and wide distribution, and because a fuller statement can be given than it is possible to send in a short telegram; and the fuller statement helps the reader to appreciate better the probable developments and so assists him in his decisions.

The Meteorological Office itself publishes a Daily Weather Report, and issues it by post in time for delivery the same evening in the neighbourhood of London, and in towns within easy reach of London, and by first post next morning elsewhere. The report ought to be regarded as supplementing forecasts published in the newspapers or sent by telegram (see below). It gives exact observations at a large number of places, so that any reader can see for himself what the temperature has been by day and by night, how much rain has fallen in the day and in the night, what has been the duration of sunshine, and the force of the wind.

The report contains also a map illustrating the distribution of weather over Western Europe, and enabling the reader to see the basis of the predictions issued, and to interpret for himself the changes which are occurring. Special arrangements are made for the issue of forecasts by telegram: the arrangements were primarily for farmers, but they are now framed with the object of meeting the requirements of all who need forecasts or warnings in their business. Briefly, (a) regular forecasts can be sent at any time of the year at about 10 A.M. or 4 P.M. or 8.30 P.M. to any address on payment of the cost of the telegrams, and a registration fee of one shilling; (b) notifications of spells of fair weather, when such spells are anticipated, are issued and are followed by one or more messages indicating the progress of meteorological events, and warning when the spell is about to break. The recipient pays the cost of telegraphy and 6d. extra for each telegram; (c) notification of spells of frost, of gales, of night frost in spring or autumn, and of any special conditions, are issued by telegram to

any address, the recipient paying for each warning 2s. 6d., which includes the cost of telegraphy.

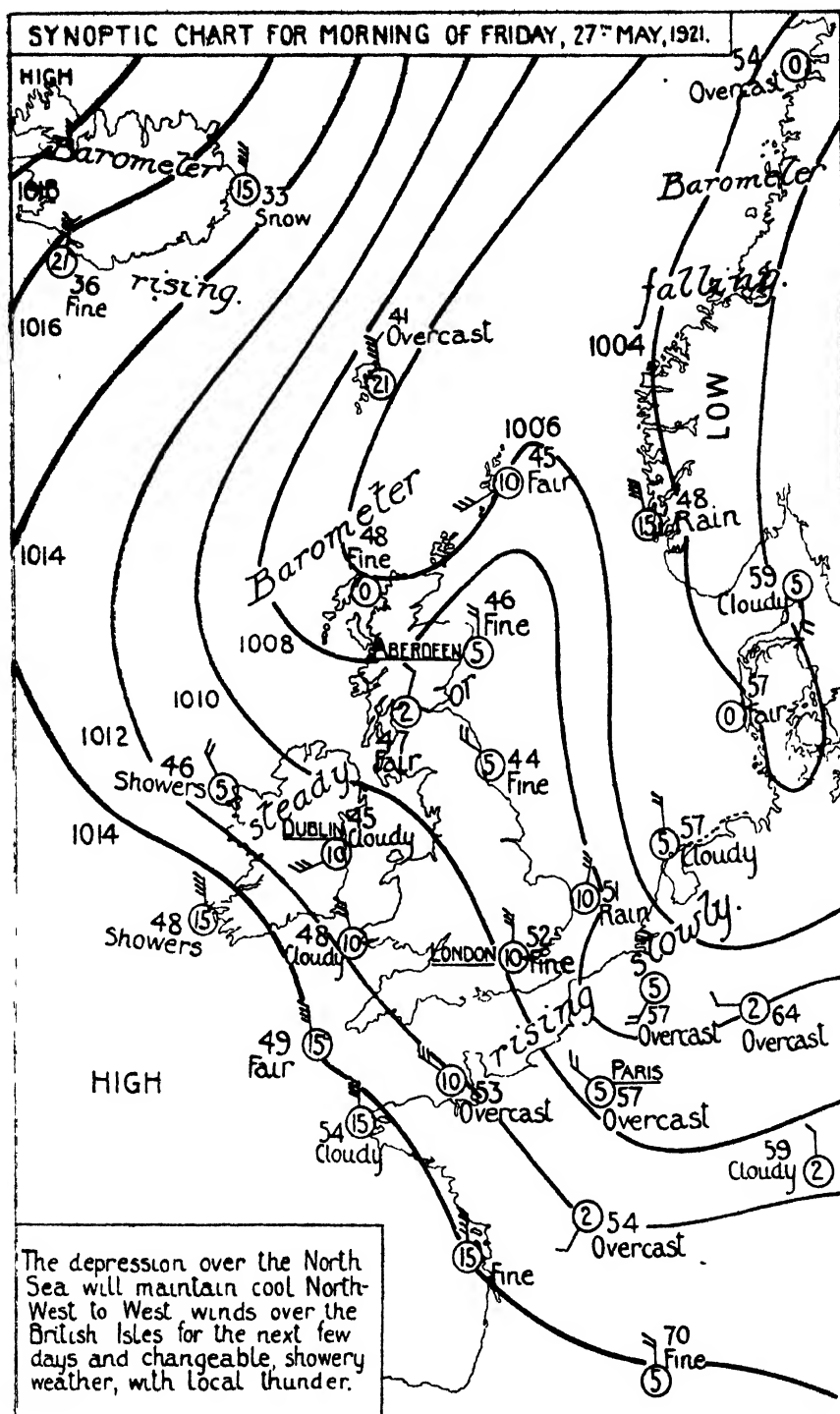
So far no steps have been taken for the display of weather signals for the use of agriculturists similar to the gale-warning signals which are hoisted at numerous places on the coast for the use of mariners. Such signals would naturally give less information than telegrams to individual farmers, but they could be devised to give useful information speedily and at much less expense than individual telegrams. For example, the setting in of fair weather, the break in a spell, the approach of frost or of severe gales could be indicated by a signal hoisted in some prominent position, and normally visible for some miles around. Such a plan at least appears to deserve consideration by local associations of farmers, as it is they who are the judges of its practicability and the gainers by any virtues which it possesses.

Much progress has been made in recent years in the distribution of meteorological information by wireless telegraphy. All European meteorological services issue some reports in this way, and it is the recognised method of meeting the requirements of aviation and of ships at sea. It may well be that a general knowledge of meteorology and of meteorological charts will form part of the mental equipment of the farmer of the future, and that, keeping his own small wireless receiving set for general purposes, he will obtain also the weather reports, which can be distributed so speedily in this way. Messages are issued four or five times daily from the Air Ministry Wireless Station, giving observations at about twenty places in the British Isles, and a general interpretation of the charts is issued twice daily.

The methods of agriculture have been largely adapted in different parts of the country to suit the average weather of the district, so that forecasts are not of equal importance to all. [Coming from the English Midlands, I recollect my interest in the methods adopted by the French in the wet part of the British army area, where they stooked the clover like corn, and in the case of wheat set a second stook, ears downwards, on the top of the primary stook, to diminish the ill effects of rainy weather.] Nevertheless every farmer who has an appreciable hay or corn harvest to gather could save much labour and worry, and thus be far more than compensated for the cost of daily telegraphic forecasts. It is largely a matter of understanding.

IV

Much work has been done in recent years in investigating the influence of the weather upon crops. The classic example is the proof by Sir Napier Shaw of a very close numerical relation between the amount of rainfall in the autumn months and the wheat crop of the following year. Every farmer knew in a general way that a bad seed-time meant a poor harvest, unless (as he invariably hoped) Providence made a special dispensation and supplied some counterbalancing factor in the weather of the next year. But nobody knew that every inch of rain above the normal amount in the autumn meant on the average two bushels per acre



less in the wheat crop. Perhaps with wheat at 3s. or 4s. a bushel it did not matter much; but with wheat at 10s. a bushel it ought to be an advantage to know at Christmas approximately what deficiency or excess the farmer should expect in next year's wheat harvest.

Sir Napier Shaw's work was developed by more advanced statistical methods by Mr R. H. Hooker, now President of the Royal Meteorological Society. He considered the effect upon crops of every two-monthly period from the beginning of the previous year (*i.e.* about twenty months before harvest) up to the time of harvest itself. Broadly speaking, a dry autumn favours the cereal and bean crops of the succeeding year, and mild weather in January and February has the same tendency, though in a less marked degree. Rain in April and May is favourable to oats and hay, whereas it is of practically no importance to barley and wheat: all cereals benefit by cool weather in May, June and July.

These results refer to the East of England, and more extended investigations in different parts of the world, notably in Sweden, India and America, indicate that for each crop there is a "best" average weather: if the rainfall or temperature of a district is normally above this "best" average, then the crop benefits by a rainfall or temperature below the normal, and vice versa. Ultimately we may hope to arrive at a selection of crops which are the most appropriate for the weather of a district, because in that way the earth will yield on the average the best return that is possible.

EXPLANATION OF THE CHART.

The arrows show the direction from which the wind is blowing towards the places in the small circles, and the number of barbs shows the force on the Beaufort Scale.

The figures inside the small circles give the speed of the wind 30 feet above the ground in miles per hour.

The figures above the words "fair," "showers," etc., give the temperature of the air at 8 A.M., Summer Time in degrees Fahrenheit.

The lines are isobars, or lines of equal pressure, along which the barometer has the same reading when allowance is made for its height above sea-level. From the height of the barometer the pressure of the air is computed and the value of this pressure is shown by the lines thus "1012."

The wind usually blows nearly along these lines, and in such a way that the lower pressure is on the right hand of a man facing the wind: the wind at 1000 or 2000 feet above ground blows with a speed which increases as the lines get closer together: if the lines are 1 inch apart the wind is about 8 miles per hour: lines $\frac{1}{2}$ inch apart—wind 16 miles per hour; lines $\frac{1}{4}$ inch apart—wind 32 miles per hour.

AGRICULTURAL EDUCATION IN CANADA.

ERNEST H. GODFREY, F.S.S.,

Dominion Bureau of Statistics, Ottawa.

At the Confederation of Canada, under the British North America Act of 1867, the right to legislate on education was reserved exclusively to the Provincial Legislatures. Each of the nine provinces of Canada has therefore striven to meet the educational needs of its own people, and co-ordination for the Dominion as a whole is secured, where possible, only through the inter-provincial association of educational experts. This does not mean that the Dominion Government has not concerned itself at all with agricultural education. On the contrary, the Dominion Department of Agriculture, through numerous and varied activities, and especially through the Experimental Farms and Stations, has long exercised an important educational influence, though rather in the direction of adult than of juvenile instruction.

Agricultural Instruction Act.—Within recent years, and following the example set by the Agricultural Development Board in Great Britain, the Dominion Government has taken more direct action towards the improvement of agricultural education throughout Canada. By the Agricultural Instruction Act, 1913 (3-4 Geo. V., c. 5), a sum of \$10,000,000 was appropriated for the ten years ending 1923, to be expended in annual grants to the Provincial Governments for the purposes of agricultural instruction. For the first three years the total grants were, respectively, \$800,000, \$900,000 and \$1,000,000 per annum; but for the year 1918, and until the expiration of the Act in 1923, the annual grant is \$1,100,000. Of this sum \$20,000 are shared between the two Canadian Veterinary Colleges (one in Ontario, the other in Quebec) in proportion to the number of students. The remainder of the grant is distributed to the Provincial Governments in proportion to the population as determined by the latest decennial census. Needless to say, the provision of these sums in aid of agricultural instruction is already giving excellent results, and the effect will be cumulative with time. One almost immediate effect of the Act has been to promote a spirit of closer friendly co-operation between the Dominion and provincial agricultural authorities. It is administered on behalf of the Dominion Government by a Commissioner, who presents an annual Report to the Minister of Agriculture.¹

¹ *Report on the Agricultural Instruction Act for 1919-20.* Ottawa, 1921.

The following statement shows how the grant of 1918-1919 was allocated as between the nine provincial Governments :—

Province.	Population 1911.	Amount Canadian Currency.	Amount British Currency (Exchange at par).
Veterinary Colleges . . .	...	\$ 20,000'00	£ 4,110
Prince Edward Island . .	93,728	31,749'22	6,524
Nova Scotia	492,338	81,716'69	16,791
New Brunswick	351,889	64,110'80	13,173
Quebec	2,003,232	271,113'76	55,708
Ontario	2,523,274	336,303'26	69,103
Manitoba	455,614	77,113'11	15,845
Saskatchewan	492,432	81,728'48	16,794
Alberta B.	374,663	66,965'62	13,760
British Columbia	392,480	69,199'06	14,219
Yukon and N.W. Territories	26,993	...	...
Total	7,206,643	1,100,000.00	226,027

During the fiscal year, ended 31st March 1919, the amounts actually expended under the divisions of work to which the grant was applied were as follows, the expenditure in subsequent years being similarly distributed :—

Division of Work	Canadian Currency.	British Currency.
Agricultural Colleges and Schools . .	\$ 282,851	£ 58,120
Instruction and Demonstration . . .	621,450	127,695
Women's Work	27,047	5,558
Elementary Agricultural Education (including school fairs in part)	163,647	33,626
Boys' and Girls' Clubs	15,556	3,196
Veterinary Colleges (including special vote in Quebec agreement)	25,000	5,137
Total	1,135,551	233,332

This division is necessarily not quite exact, because of the inter-relationship between the different branches of educational work. Two recent developments of considerable importance, depending directly upon the grants made by the Act, are : (1) the work which comes under the heading of "Instruction and Demonstration"; and (2) that which relates to women. Under the former the grant bears either the whole or a large proportion of the cost of maintaining agricultural representatives and their offices. These representatives are local resident agents of the provincial Department of Agriculture, selected from graduates of the Agricultural Colleges; their duties include the giving of short courses of agricultural instruction to farmers, and the organisation of boys' and girls' clubs, school fairs and other cognate undertakings. In addition, the grant under this heading includes special propa-

ganda, undertaken by the provincial Departments of Agriculture for the promotion of better farming, demonstrations in fruit-growing, poultry and bee-keeping, co-operative marketing, field husbandry, dairying and live stock. Women's work includes household science, hygiene, home-making, dressmaking and home nursing, and is assisted by the grant in the majority of the provinces through women's institutes or equivalent organisations.

Bearing in mind that the various activities of the provincial Departments of Agriculture are receiving material assistance under the Act, we proceed to consider the more direct agricultural educational efforts of the provincial educational authorities in the schools, colleges and universities of the Dominion.

Agricultural Education in Elementary and Secondary Schools.—

Without attempting to describe the general educational system of Canada it may be explained that the elementary schools of the Dominion, in some provinces described as "public schools," correspond generally to what were formerly called Board Schools but are now called "provided" schools in England. In some provinces, as, for instance, in the Prairie Provinces, the public school system is unified, elementary education being given in the lower and secondary education in the higher grades; but in all provinces provision is made for high school education in natural gradation from the elementary classes, and a proportion of the students proceed to college and university. Education amongst the French-speaking population of the province of Quebec is controlled by the Roman Catholic Church.

Agriculture has long been included as a subject to be taught in the rural elementary schools of Canada; but it is only within quite recent years that any real progress has been made in the direction of effective teaching. Formerly it was attempted to be taught by means of a textbook alone, the teachers in the majority of instances having little knowledge of and no enthusiasm for agriculture. Now in many of the rural elementary schools of the Dominion agriculture is a subject taught by teachers with a certain amount of qualification for the work under the general control of a director, the arrangements being made in some instances by co-operation between the provincial Departments of Education and of Agriculture. In Ontario, the Department of Education provides for instruction in elementary agriculture and horticulture in the public and separate schools,¹ wherein the instruction is based on the personal observation, investigation and experimentation of the pupils themselves, and not on lessons in a book, no textbooks being prescribed. The work is under the direction of an Inspector of Elementary Agricultural Classes, who reports to the Minister of Education. His duties include a general supervision of the teaching of agriculture in the public and separate schools, the inspection of agricultural classes in collegiate institutes, high schools, continuation schools and normal schools, and supervision of summer courses for teachers at the Ontario Agricultural College. At present agriculture is an optional subject, dependent upon the decision of the local boards of trustees.

¹ Schools for the Roman Catholic minority are termed "Separate Schools."

An essential part of the teaching of agriculture in the public schools is the provision of school gardens, or, where these are not possible, of home gardens, which the pupils cultivate practically under the general supervision of the teachers and which serve in a way that no textbook or merely oral demonstration can to awaken interest, train intelligence and educate effectively the faculties of children.

Amongst the Ontario Teachers' Manuals authorised by the Ontario Minister of Agriculture is one on Elementary Agriculture and Horticulture. This gives plans for the making and conduct of school gardens, describes the management of home gardens and discusses the various projects of cultivation to be taken up with the pupils. School Progress Clubs are another means of promoting agricultural education by connecting the work of the schools with the interests of the home and community. The membership comprises pupils, ex-pupils, teachers and parents. For the younger children agriculture comes rather under the term of Nature Study, whilst in the older classes, and especially in connection with secondary education, the principles of agriculture are taught under carefully graded schemes. In Ontario, for the older pupils, school fairs, separate from the regular agricultural fairs, are held for the competitive display of produce of school gardens and home projects, prizes being awarded to successful competitors.

The District Representatives of the Department of Agriculture co-operate with the teachers and the public school inspectors. Other features are the institution by the Department of boys' and girls' clubs for the keeping of pigs, poultry, and the rearing of calves, as well as juvenile potato-growing competitions. The object is to rouse the interest, not only of the pupils, but also of the parents, and to educate country boys and girls along practical lines.

A boys' potato-growing contest held annually in two counties close to Ottawa may be cited as a pioneer instance of successful agricultural education of a practical character. In the spring of 1912 the late Mr R. B. Whyte of Ottawa inaugurated potato-growing contests for boys in competition for prizes provided by himself, the competition being open to boys between the ages of fourteen and eighteen. Full records were kept of costs, yield and value, and the competitors were required to write practical essays on their work and its results. Usually the special care bestowed upon their plots ($\frac{1}{10}$ acre in size) resulted in considerably higher yields than those obtained by parents or other practical farmers, and the competitions have had important results in stimulating local effort independently of the present and prospective value of the competitions to the boys themselves. The prizes are presented at public meetings, at which practical addresses on potato-growing and upon the results of the competition are given by potato experts. Mr Whyte, who died in 1918, provided by his will for the continuation of the contests after his death and also for similar horticultural competitions amongst girls, which had previously been held by him.

In the Atlantic provinces (Prince Edward Island, Nova Scotia

and New Brunswick) elementary agricultural education is carried on along similar lines, nature study being especially undertaken by the youngest pupils, whilst school gardens, home gardens, school fairs, poultry and other projects form part of the system of public school education. The teachers are also encouraged to undertake winter reading courses and experiments in order to make themselves more efficient in the teaching of agriculture. In Nova Scotia the subject comes under the more general term of Rural Science. There is a Director of Rural Science and a School of Rural Science for the annual training of teachers, during the summer vacation, at the Truro College of Agriculture. In New Brunswick the Director of the Elementary Agricultural Education Division of the Provincial Department of Agriculture reports that work in connection with the home project is developing rapidly, the distribution of seed for home gardens attaining over 4500 packages of seed, including 82 bushels of potatoes in 6-lb. packages. For the assistance of the teachers a Summer Camp was introduced last year in connection with the Rural Science School, and a Rural Education monthly is circulated amongst the teachers in the interests of practical agricultural education.

In Quebec the teaching of agriculture receives constant attention in the rural schools and is stated to be making most satisfactory progress. Under the provisions of Article 3040 of the Revised Statutes of Quebec agriculture is taught in all schools in the rural municipalities. The statutory regulations of the Roman Catholic Committee provide for the teaching of the subject in three school courses—viz. elementary, intermediate, and academic or superior. Teachers are instructed that the lessons in agriculture should not be “too bookish,” but should consist in exercises of observation in fields and gardens. There is also an elaborate programme for the graded teaching of domestic science, including agriculture and horticulture. In the Protestant schools of the province agriculture and nature study are taught in Grades I.-V., and agriculture is taught in Grades VI.-VIII. In 1918 there were 945 gardens attached to rural schools, by which 22,761 pupils benefited.

In the western provinces earnest efforts are being made in the same direction. In Manitoba agricultural education for secondary pupils is carried on largely through the medium of Boys' and Girls' Clubs, which form part of the work of an Extension Service of the Provincial Department of Agriculture and Immigration working in close co-operation with the Department of Education. There are about 240 of these clubs in the province. In Saskatchewan, under the Department of Education, there is a Director of Rural Education Associations and School Exhibitions. Mr Fred W. Bates, M.Sc., the present holder of this office, writes as follows :—

After many years of trial and experiment and much failure, the place of agriculture as a subject of study in the elementary school is firmly established, but the problem is so to simplify the work that the average teacher may handle it satisfactorily. A few years ago a complete revision of the course was made in order to make it more practical and more easily directed. It was felt that the proper method of approach was through nature study; hence a Nature Study Course was outlined for Grades I.-VI. Beginning with simple observa-

tions of familiar natural phenomena the pupil is gradually led to a direct study of every phase of his environment, his natural instincts to collect, roam and dig in the ground being utilised through excursions, "hikes," making collections and through garden operations.

In Grades VII. and VIII. agriculture is introduced as a formal subject, divided into the sections of Plant Life, Weeds, Crop Production, the Soil and Farm Implements. To assist the teachers in the field lectures and discussions are held at conventions and institutes, special courses in agriculture are conducted at the Summer School for teachers, and general aid is given through correspondence and personal direction. Special instruction is also provided in the Normal Schools for the training of teachers.

In Alberta the teaching of agriculture is compulsory in the public schools, both rural and urban, and in cities horticulture receives special emphasis. In the public schools the teaching of agriculture belongs to Grades VII. and VIII., which relate to the last two years in elementary work. Before this the work is designated as "Nature Study" and begins in the first grade. An authorised textbook, entitled *Elementary Agriculture for Schools*, is furnished free to all pupils of Grades VII. and VIII. Agriculture is a compulsory subject in Grade XI., which represents the third year of the High School for intending teachers.

A special feature of agricultural education in Alberta is the schools of agriculture established specially to provide the sons and daughters of farmers with the type of education that will best fit them for their agricultural life work. These schools, at present six in number, are situated at Claresholm, Olds, Vermilion, Gleichen, Raymond and Youngstown, and are managed by a Board of Agricultural Education of nine members, three of whom must be graduates of an agricultural college. The Board, together with the Minister of Agriculture, prepares the scheme of practical and scientific work of the students, prescribes the course of study, appoints the examiners and acts as General Advisory Board to the Minister in matters of agricultural education. The chief officer of the Board is known as the Superintendent of Agricultural Schools. The session for each school lasts from the end of October to the end of March, with a ten days' Christmas vacation, and the work is carried on in the two main divisions of Agriculture for boys and Household Science for girls. The agricultural course, which extends over two years, embraces animal and field husbandry and farm mechanics. It includes instruction in farm management, farm book-keeping, agricultural physics, chemistry, bacteriology, mathematics and English. Satisfactory completion of the two years' course entitles the student to receive the Associate Diploma and furnishes the standing demanded for entrance into the Faculty of Agriculture in the University of Alberta.

In the Department of Household Science the aim is to train the young women of the province to be practical home-makers. Covering a period of two sessions of five months each, the work of the second year is designed, in addition to the home-makers' course, to assist those preparing to be teachers in domestic science. For both sexes the minimum age of admission is sixteen and the school course is entirely free. A considerable number of prizes

provided by associations and individuals are offered for competition by the students. For the girls the course of study in home economics includes cooking, foods, dietetics, physiology and anatomy, hygiene, home nursing, sewing, textiles, embroidery, laundry, household administration, sanitation, home book-keeping, English, mathematics, horticulture, home dairying, poultry, chemistry, bacteriology, civics and physical culture.

At each of the schools considerable experimental work is conducted, and one advantage of these smaller schools is that the experiments have closer relation to the agricultural problems of a particular locality than is possible where the experiments must be on a provincial scale in connection with the Agricultural College and University. Experiments at the schools relate to the best varieties of grains and vegetables, the proper rates and dates of seeding, the crops that give the greatest yield of green feed and ensilage and the most suitable crops for hay and pasture. Other experiments are conducted to test the rotations which give the best financial returns, to ascertain the best cultural methods and the proper use of manure; chemical analytical studies ensure more intelligent interpretation. Dry farming methods that will overcome the effects of drought and reduce the losses in dry years are being extensively investigated.

In three other provinces special agricultural schools of less than college grade have recently been established in a tentative way, designed to give instruction in vocational agriculture. The objective of all these schools is better to equip country boys and girls for practical farming and home-making. They lead directly to agriculture as a vocation and are also preparatory to more advanced courses at the colleges of agriculture. The agricultural school at Kemptville, Ontario, is associated with a farm of 300 acres, and is equipped with a main building, a judging pavilion and gymnasium, an engineering building and a poultry plant, in addition to the regular farm buildings. The intention is to make this a residential school.

In British Columbia there is a Director of Elementary Agricultural Education under the Superintendent of Education, who is the Chief Officer of the Education Department. Under the Director are District Supervisors, the number of whom is being gradually extended. The present policy and plans for the teaching of agriculture in the province date from 1914, but agriculture was placed in the curriculum for graded and common schools in 1896. At first compulsory, it was in the following year made optional. The plan was not successful, because it was not then recognised, as it is now, that agriculture must be taught practically and not in sole dependence upon textbooks and pamphlets. As now organised the subject is divided into Rural Science in the public elementary schools (which includes nature study, school gardening and elementary agricultural studies), agriculture in the High Schools, and the improvement of school grounds. The preparation of teachers is effected primarily through the High School and the Normal Teacher Training Schools, but also more specially through vacation courses at a Summer School held in July.

Higher Agricultural Education.—With only one exception, every province of Canada has either its Agricultural College or Agricultural Department of the University. Each offers a four or five years' course, leading to the degree of Bachelor of Science in Agriculture, which is abbreviated as B.S.A. A common requirement is that students entering for this course must have had at least one year's practical work on a farm, or must fulfil a similar requirement during the earlier years of the course. Two of the principal Agricultural Colleges are situated respectively at Guelph in the province of Ontario, and at Ste. Anne de Bellevue in the province of Quebec. An important difference between the organisation of these colleges and that of the agricultural colleges in Great Britain is that in the two Canadian colleges the work comprises practically the whole of the large field of agriculture, whilst the British colleges specialise more in the agriculture of their respective counties or groups of counties. The Ontario Agricultural College and Experimental Farm, an institution of the Provincial Government, administered by the Ontario Department of Agriculture, was established in 1874 to train young farmers in the science and practice of agriculture and to conduct agricultural experiments for the benefit of the province. The land property consists of 700 acres of average loam soil. The farm occupies about 500 acres, the experimental plots about 100 acres and the campus and wood lots form the remainder. For the academic work there are at present sixteen large buildings for dormitories, class-rooms and laboratories, in addition to barns, stables, storage-houses and dwellings. The principal buildings comprise the men's residence, providing accommodation for 230 students, and the dining-hall, completed in 1914, with a seating capacity for 500. The Massey Hall and Library, provided by the generosity of the late Mr Hart Massey, was erected in 1901. The hall, with a seating capacity of 450, occupies the ground floor, and is used for roll call, Sunday services, literary society meetings, concerts, etc. On the upper floor is the library, containing over 26,000 volumes, to which the students have easy access. The other buildings are for biology (including botany and entomology), physics, horticulture, chemistry, field husbandry and animal husbandry and bacteriology. A judging pavilion, with seating accommodation for 300, is used for practical work in live stock. There are also the machinery hall and buildings for the dairy and for poultry.

Within the College grounds stands also the Macdonald Institute, which is equipped for the training of farmers' daughters in home economics, both in long and short courses. They comprise the theory and practice of cooking, general housekeeping, laundry work, sewing, dressmaking, millinery, home decoration, etc. Female students are boarded in the Macdonald Hall, an Elizabethan building erected in 1904 as the generous gift of the late Sir William Macdonald of Montreal.

The following is a complete statement of the various courses of study offered by the College in the four departments of (I.) Agriculture ; (II.) Home Economics ; (III.) Manual Training ; and (IV.) Nature Study :—

I. DEPARTMENT OF AGRICULTURE.

	<i>Duration.</i>
1. Course leading to the Degree of Bachelor of the Science of Agriculture (B.S.A.)	4 years
2. Two-year course following two years at either of the Universities of Toronto, Queen's (Kingston) or McMaster (Toronto), leading to the Degrée of Bachelor of Science in Agricultural (B.Sc.(Agr.))	2 "
3. Associate Diploma of the College	2 weeks
4. Factory Dairyman	12 "
5. Farm Dairy	4 "
6. Summer Dairy	5 months
7. Cow Testing	10 days
8. Ice Cream Making	1 week
9. Soft and Fancy Cheese Making	1 "
10. Poultry	4 weeks
11. Stock and Seed Judging	2 "
12. Horticulture	6 "
13. Bee-keeping	2 "
14. Farm Drainage and Surveying	2 "
15. Farm Power	2 "

II. DEPARTMENT OF HOME ECONOMICS.

1. Normal Course in Domestic Science	2 years
2. Associate Course (Non-Professional)	2 "
3. Housekeeper	2 "
4. Home-maker	1 year
5. Domestic Science	3 months

III. DEPARTMENT OF MANUAL TRAINING.

Teachers' Normal Course	1 year
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IV. AGRICULTURAL COURSES FOR PUBLIC AND HIGH SCHOOL TEACHERS.

1. Public School Teachers	5 weeks
2. Science Teachers	5 "
3. Farm Mechanics	2 "

Tuition fees for residents¹ of Ontario are \$20 per annum for first and second year, and \$50 per annum for third and fourth year students. Students from other provinces and from Newfoundland pay \$50, and students from outside of Canada and Newfoundland \$100 per annum. Board at the College costs \$5 per week. There are small fees for membership in literary, athletic and philharmonic societies, and there are credit payments for manual labour by students in outside departments. Altogether it may be estimated that the cost of a four years' course to residents in the province, including miscellaneous expenses, amounts to about \$800, or, say, \$200 a year, in addition to the cost of clothing. It is therefore possible for a farmer's son to obtain a high-class Agricultural Diploma, carrying with it the possibility of valuable appointments in expert capacities at very moderate cost. A young agricultural student, by working as farm help during the summer, can usually earn the major portion, if not the whole of the amount necessary to put himself through College. An Experimental Union, under College direction, has existed for

¹ Residents of Ontario are defined as those whose parents are ratepayers or *bona fide* residents of the province.

many years for the conduct of practical agricultural experiments in all parts of the province.

As the result of a special inquiry made in 1919 it was ascertained that, approximately, 20,000 students of both sexes have enrolled at the College since its establishment in 1874. About 4500 entered the regular agricultural course, 8100 the winter short courses, 2800 the summer short courses, 200 the manual training course and 4700 the long and short courses in home economics. Of 4491 registrations in the regular agricultural course, 554 are of students now in attendance and 3937 are of ex-students. Of these ex-students 1574 received the Associate Diploma in Agriculture granted by the College at the end of the two-year course, and 698 the B.S.A. degree at the end of the complete course. Eighty per cent., or four-fifths, of the ex-students of the regular course, being 80 per cent. of the Diploma men and 92 per cent. of the B.S.A. graduates, are engaged in agricultural work. Five ex-students who are farmers fill the position of Premier, Minister of Agriculture, Provincial Secretary, Minister of Education and Minister of Public Works in the Ontario Government, and ex-students who are engaged in agricultural work other than farming include officers in Government Agricultural Departments, Agricultural College and University Presidents, professors and investigators, agricultural editors, agricultural representatives, members of the Soldier Settlement Board, cheese-makers, butter-makers, drovers, farm managers, etc. The remaining 20 per cent. not engaged in agricultural work include clergymen, missionaries, lawyers, veterinary surgeons, implement agents, flour millers, produce dealers, bakers and manufacturers.

Next in point of size is the Macdonald College, situated at Ste. Anne de Bellevue on the Ottawa river, about twenty miles west of Montreal. It was established in 1907 by the public-spirited munificence of the late Sir William Macdonald, of Montreal, who not only bore the cost of the land, buildings and equipment of the college, amounting to over \$2,500,000, but provided also for its future maintenance by a Trust of over \$2,000,000. The College is now incorporated with the McGill University, and the property comprises 786 acres, divided as follows:—main farm, 584 acres; cereal husbandry plots, 75 acres; poultry department, 17 acres; orchards, 35 acres; vegetable gardens, 25 acres; and the campus, including driveways, lawns, trees, shrubs, flower beds, school garden and recreation fields for both sexes, 50 acres. The College is divided into three schools: (1) the School of Agriculture, aiming to provide a theoretical and practical training in the several branches of agriculture; (2) the School for Teachers; and (3) the School of Household Science. As in the case of the Ontario Agricultural College there is a four years' agricultural course, qualifying for the degree of Bachelor of Science in Agriculture (B.S.A.), and there is also a two years' course, following two years at the McGill University, which qualifies for the degree of Bachelor of Science in Agriculture (B.Sc.(Agr.)).

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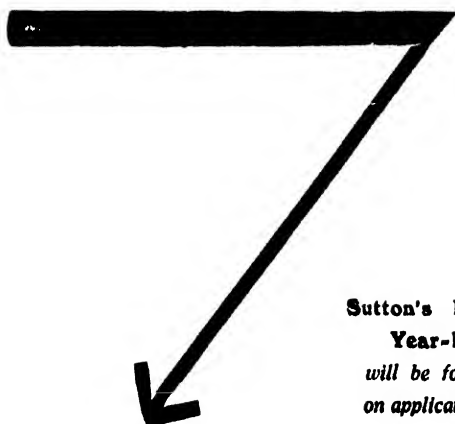
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building has a complete system of ventilation, whereby fresh air (warmed in winter) is furnished to every room. The buildings are heated by steam, lighted by electricity and supplied with filtered water from the College power-house. A system of tunnels provides for the distribution of heat, light, power, water and gas, and in the winter students may pass from building to building by subterranean passages. In the main building are offices for the principals of the three schools, for the bursar and for their respective staffs. An annex on the ground floor contains reading-room with accommodation for 150 readers and a library with stack-room accommodation for 13,000 volumes. Above these rooms is the assembly hall, with a seating capacity for about 650. It contains a modern three-manual pipe organ and grand piano. On the first floor are laboratories and workrooms for nature study and manual training, and on the second and third floors are classrooms, offices and laboratories of the schools for teachers and household science. Other large buildings include those for biology and bacteriology; for chemistry and physics; for the High School; for agriculture and horticulture and for poultry. The men's residence has accommodation for 175 and the women's for over 200. Both have excellent accommodation for a great variety of purposes, including large gymnasias and swimming pools. In the women's building is the large College dining-hall used by the students of both sexes, who meet occasionally under well-regulated conditions for social intercourse and recreation.

To the sons and daughters of farmers in the province of Quebec the tuition in the School of Agriculture is free for the first and second years, and for the third and fourth years the fees are \$50 per annum. Other residents of Canada pay \$50, and students from outside of Canada \$100 per annum. In the School for Teachers the tuition is free to residents of the province of Quebec. In the School for Household Science daughters of farmers of the province of Quebec receive tuition free; other residents of Canada pay \$100 per annum and students from outside of Canada pay \$125. For the short courses in this school farmers' daughters of the province of Quebec also receive tuition free. For board and lodging the charge is \$7 weekly for each occupant of a room with two single beds. There are a few single rooms, for which the charge is \$8 weekly. The expense to students from the province of Quebec is further lessened by a grant of \$7 each per month of attendance, the amount being placed to the credit of such student by the bursar and applied to the account for board and lodging. Altogether the cost to a Quebec student for a four years' course in the School of Agriculture may be estimated at about \$1000, or \$250 per annum.

Having dealt somewhat in detail with the two principal Agricultural Colleges of the Dominion it will be unnecessary to do more than describe very briefly the remaining institutions for higher agricultural education in Canada. In the Atlantic Provinces, situated at Truro, Nova Scotia, is the Truro Agricultural College established in 1888. The College property consists of five buildings on 390 acres of land, including 65 acres of diked marsh land, 170 acres of intervale and upland pasture and 155 acres of upland

arable soils. The five buildings comprise the main building, and buildings for science, horticulture, dairying, and a pavilion for the judging of live stock. Provision is made for a two years' course qualifying for the Diploma of "Associate of the College of Agriculture," this being as nearly as possible the equivalent of the two years' course with Associate Diploma of the Ontario Agricultural and Macdonald Colleges. Possession of this Diploma entitles students to enter the other Agricultural Colleges of Canada in the third year in order to complete the four-year course for the degree of B.S.A. Tuition at the College is free to all residents of Canada, and students are boarded in private houses at Truro at rates of from \$5 to \$8 per week. The cost of the two-year course, exclusive of railway fares dependent upon distance, is about \$150. In Prince Edward Island there is an Agricultural Department of the Prince of Wales College at Charlottetown, whence agricultural students may proceed to one of the larger Agricultural Colleges in other provinces.

Serving the needs of French-speaking agriculturists in the province of Quebec are two schools of agriculture—viz. the Oka Agricultural Institute, near the Lake of Two Mountains, about twenty miles from Montreal, and the School of Agriculture at Ste. Anne de la Pocatière, near Quebec. The former, one of the oldest experimental farms in Canada, is fitted to board 150 pupils. Horticulture is practised largely and small fruits are a specialty. The Oka cheese is famous throughout North America. The Institute is affiliated to the Roman Catholic University of Montreal. The school at Ste. Anne de la Pocatière provides a four years' course in Agronomy and a two years' course, successful students in the Agronomy course receiving the degree of B.S.A. from the Laval University of Quebec, to which the school is affiliated. Other successful students receive a certificate of Agricultural Proficiency (*Brevet de Capacité Agricole*).

In each of the Prairie Provinces (Manitoba, Saskatchewan and Alberta), and also in British Columbia, are Colleges or Departments of Agriculture forming part of the provincial Universities. They are of quite recent establishment, except in the case of the Manitoba Agricultural College. This was established by Act of the Provincial Legislature of 1903. Building operations began in 1905 and the College was opened in 1906. In 1907 the College was affiliated to the University of Manitoba and in 1912 it received degree-conferring powers. The College is governed by a board of ten directors, of whom four are elected by the directors of the Live Stock and Grain Growers' Associations and five are appointed by Order in Council. The College buildings are eight in number, comprising: (1) Administration; (2) Horticulture and Biology; (3) Chemistry and Physics; (4) Engineering; (5) Dairy; (6) Stock Judging Pavilion; (7) Poultry; and (8) the Students' Residence. The last named has accommodation for 300 men and 200 women students, and an auditorium, with a seating capacity for 1200, used as an assembly hall for all the students and for farmers' conventions, entertainments and the final examinations. A Diploma in Agriculture is awarded by the College on completion of a three years' course in Agriculture and a Diploma in Home

Economics on completion of a two years' course. Degrees of **Bachelor of Science in Agriculture (B.S.A.)** and **Bachelor of Home Economics (B.H.E.)** are awarded by the University of Manitoba on completion of the five years' course. There are also eight **Special Courses** of varied character, and a new feature introduced in 1919 is a series of correspondence courses, comprising eight subjects of practical agriculture. The tuition fee for each of these courses is \$10. In Saskatchewan the College of Agriculture, forming part of the University, has over 1300 acres of land at Saskatoon and another 560 acres, about 35 miles distant, which were bequeathed to the College by the late Mr J. R. Proctor, a pioneer settler and ex-student of the University of Cambridge, England. In Alberta the College of Agriculture forms part of the new University at Edmonton South. Here, students who complete two years at the Schools of Agriculture, already described, may enter the College for a three years' course leading to the B.S.A. degree. In British Columbia, at Point Grey, near Vancouver, there is at the new Provincial University, incorporated under Act of the Provincial Legislature of 1908, a Faculty of Agriculture in which two distinct lines of study are offered—viz. (1) a four years' course leading to the degree of Bachelor of Science in Agriculture (B.S.A.), and (2) a series of (a) short courses at the University, and (b) extension courses at different points in the province. The two latter cover a wide range of subjects in the departments of agronomy, animal husbandry, dairying, horticulture, poultry, bacteriology and biology. The fees to undergraduates are \$40 for each of the two sessions, and board and residence near the University costs from \$35 per month upwards. There are small additional fees and subscriptions and a graduation fee of \$20. Altogether the cost of taking the four-year course in Agriculture may be estimated at about \$800. The erection of the University buildings has not yet been completed.

The following is a list of the seven principal Agricultural Colleges in the Dominion of Canada, together with the date of establishment, and, for 1920, the number on the teaching staff and the number of students enrolled:—

Name and Address.	Year Established.	Number of Teaching Staff.	Number of Students Enrolled.
Agricultural College, Truro, Nova Scotia .	1888	13	392
Macdonald College, Ste. Anne de Bellevue, Montreal .	1907	57	722
Ontario Agricultural College, Guelph .	1874	60	2067
Manitoba Agricultural College, Winnipeg .	1903	38	1122
College of Agriculture, Saskatoon, Saskatchewan .	1907	16	246
College of Agriculture, Edmonton South, Alberta .	1906	19	175
Agricultural Department, University of British Columbia, Point Grey, Vancouver, B.C.	1907	15	45

It is impossible in the space at disposal to describe minutely all the different departments and phases of agricultural education in Canada. Enough has been said, it is hoped, to show what great importance is attached to agricultural education in the Dominion, so vast in extent and with a population relatively small, but predominantly agricultural. Most of the facilities now provided for agricultural education are of quite modern development and they cannot attain fruition until the young generation now enjoying them shall have arrived at maturity. Judging from the manifest signs of enthusiasm in this direction we may anticipate a rich harvest hereafter in the general improvement of Canadian agriculture.

THE SHETLAND PONY.

C. M. DOUGLAS, C.B., D.Sc.

THE Shetland pony is chiefly known as the smallest horse now existing, and its size is probably its most constant as well as its most distinctive characteristic. It is an attribute not confined to the pony, but belonging to the domestic animals of Shetland generally, since it is exhibited also by the Shetland cow, the Shetland sheep and even the Shetland collie, though in no other case is the contrast of size between the Shetland native and the animal in other places so great as in that of the pony. The fact that the live stock of Shetland are all of small size gives a strong indication that the climate or food supply of the Islands has been an important element in limiting the size of the native pony, and has sometimes led to the view that the ponies have been individually dwarfed or stunted by conditions unfavourable to their growth. Against this view, however, must be set the fact, supported by a great accumulation of experience, that the most favourable conditions of life have no tendency to increase the size of the pony, even when they are continued over several generations. The view has often been expressed that the more luxurious life of ponies in the mainland studs, and especially in the south of England, would lead to an increase of height, and that it would be possible to maintain the characteristic smallness of the breed only by frequent introduction of ponies from Shetland. This fear, however, has proved groundless, for the tendency has been towards reduction and not increase of size; and apparent exceptions to this all but invariable rule are very generally associated with a suspicion of the presence of a cross with Norwegian or other ponies of a larger race.

So strong a tendency to fixity of this general characteristic makes it difficult to ascribe it to the direct and individual influence of any dwarfing conditions; and, while the relative proportions of many Shetland ponies do indicate a certain amount of dwarfing, this must be ascribed, not to the direct effect of soil or climate, but to the indirect influence of a process of natural selection, extending over a long period. The Shetland pony is not a starveling; it is the horse whose type, qualities and size enabled it to endure the conditions of life in Shetland, conditions in which larger horses

would not in earlier times have survived and which still prohibit any considerable increase in the size of a horse which is to be exposed without protection or help to their full severity.

The influence of natural selection has, no doubt, been increased, and its results have been stereotyped by inbreeding, which has always been prevalent in Shetland as a result, not so much of intention as of carelessness, chance, and the isolation that accompanies the separation of islands and the intersection of the mainland by long voes or arms of the sea. These are the influences which account for the fixity and permanence of that small size which is the principal common characteristic of the breed.

Origins and Early History of the Breed.—That there was a native pony in Shetland before the Scandinavian invasions of the ninth and subsequent centuries has long been believed ; and this is supported by the fact that the Bressay Stone—an accredited relic of Celtic Christianity in Shetland—displays a representation of a pony ; but it is now further confirmed by the discovery (in 1911) in the kitchen midden of the Pictish broch, at Sumburgh, of bones identified by Professor Cossar Ewart as those of a pony under twelve hands high. Rock drawings belonging to pre-historic times show also that in these times Norway contained horses or ponies ; and it may be conjectured that the Scandinavian invaders brought horses to Shetland. The resemblance, on a smaller scale, of many Shetland to Norwegian ponies is highly suggestive of a partially Norse origin of the pony as we have it now. But there is also clear evidence of another element in its origin, for there are many ponies of what can only be termed Oriental type, long-shouldered, fine in head and with an Arab outlook altogether alien to the Scandinavian breeds. That these are due to a separate element in the origin of the pony is confirmed by the fact that ponies of this type do not exist as pure or continuous strains, but crop out here and there, apparently as "sports." No attempt has so far been made to produce, by interbreeding, a race true to this type.

What the origin of this strain, within the breed, may have been is a matter of conjecture rather than of knowledge. Oriental ponies may have been brought back by Jarl Rognvald of Orkney from his Crusade after the year 1152, or they may have been landed by the Spanish Armada, since its transport animals were certainly carried in the "Armada de Urcas," whose flagship was wrecked on the Fair Isle. It should not be lost sight of, however, that the pony portrayed on the Bressay Stone is of a definitely Oriental type, with high carriage, a fine head and short back, so that the pre-Scandinavian pony may itself be the progenitor of the quasi-Oriental strain.

The Unimproved Pony.—The small pony of Shetland is recorded by travellers in the seventeenth century. It is clearly referred to by Captain John Smith in 1633. "Their Horses, which they called Shelties, some of which I have seen, are little bigger than Asses, but very durable."¹

¹ *A Description of the Islands of Shetland, etc.*, p. 250. Scottish History Society. 1908.

In 1701 we have a full and clear description by Brand, which places beyond doubt the identity of the Shetland pony of that time with the breed as we have it now:

"I think the kine and sheep are of a greater size than they are in Orkney, though their horses be of a less; they have a sort of little horses called shelties, than which no other are to be had if not brought hither from other places; they are of a less size than the Orkney horses, for some will be but nine, others ten nives or hand-breadths high, and they will be thought big horses there if eleven, and although so small yet they are full of vigour and life, and some not so high as others often prove to be the strongest, yea there are some whom an able man can lift in his arms, yet will they carry him and a woman behind him eight miles forward and as many back; summer or winter they never come into a house, but run upon the mountains in some places in flocks, and if at any time in winter the storm be so great that they are straitened for food, they will come down from the hills, when the ebb is in the sea, and eat the sea-ware (as likewise do the sheep), which winter storm and scarcity of fodder puts them out of case, and bringeth them so low, that they recover not their strength till about St John's mass-day, the 24th of June, when they are at their best: they will live to a considerable age, as twenty-six, twenty-eight or thirty years, and they will be good riding in twenty-four, especially they will be the more vigorous and live the longer, if they be four years old before they be put to work.

"Those of a black colour are judged to be the most durable, and the pied often prove not so good: they have been more numerous than they are now; the best of them are to be had in Souston and Eston, also they are good in Waes and Yell, these of the least size are in the Northern isles of Yell and Unst.

"The coldness of the air, the barrenness of the mountains on which they feed, and their hard usage may occasion them to keep so little, for if bigger horses be brought into the country, their kind within a little time will degenerate; and, indeed, in the present case we may see the wisdom of Providence, for their way being deep and mossy in many places, these lighter horses come through, when the greater and heavier would sink down: and they leap over ditches very nimbly, yea up and down rugged mosses, braes or hillocks with heavy riders upon them, which I could not look upon them, but with admiration, yea, I have seen them climb up braes upon their knees, when otherwise they could not get the height overcome, so that our horses would be but little if at all serviceable there."¹

In 1801 their manner of life is described in a Highland Society's Report²: "The horses live in the open fields, summer and winter, night and day, and never get a mouthful except what they can gather, not even when the ground is covered with snow. At the season of labour they are, of consequence, miserable, lean, and weak; so late as the middle of June they are little else than skin and bone, covered with long hair like goats, yet, even in that situation their spirit is astonishingly great."

¹ *A Brief Description of Orkney, Zelland, etc.*, pp. 77-79. Edinburgh. 1701.

² *Publications*, vol. ii., p. 7.

"They would be more numerous," says Gifford, "if in any way cared for; but they lie out in the open fields summer and winter, and get no food but what they can find for themselves; so in bad winters many of them die with hunger and cold. It will, no doubt, be wondered at by strangers that so little care is taken about these sheep and horses which are so useful and beneficial; the reason whereof is, that the poor inhabitants, having used their utmost endeavours, can scarce find food and shelter for their oxen and cows, without which they could not live; and in hard winters many of them die for want of fodder, so they have none to bestow on their sheep and horses, until they find more time to improve the land."

The conditions here described, though now rather less severe, are substantially those in which the pony still exists in the Islands. They are, indeed, the only conditions of life which Shetland offers, and although the lot of the pony in his native islands is not luxurious, it is not found to be inconsistent with health or robustness; indeed, he seems to thrive better even when he is exposed to severe weather conditions than when kept indoors.

Two facts must be kept in view in considering the development of the pony at this stage. The first is that in his native islands he was used only as a saddle and pack pony and not in harness; for there were no roads in Shetland until they were constructed, after the potato famine of 1847, in order to afford work to relieve the distress which followed it; and the formation of roads led, later on, to the importation or development of larger ponies, such as are now common in Shetland, which are better adapted for use in wheeled vehicles. There was thus no great advantage even in the earlier half of the nineteenth century in improving the draught qualities of the pony.

On the other hand it is equally evident from contemporary accounts there was not, at that time, any definite intention of breeding specially small ponies. The Highland Society's Report, already quoted, criticises the habit of preserving as stallions "the most unpromising of the young of the species." Larger and not smaller ponies were desired; those who were interested in the breed regarded the decline in size with alarm; competent observers reported that "the ponies are now much smaller in size than they were thirty years ago, entirely owing to the fact that all the best and stoutest are exported, and stallions of the most puny size are allowed to go at large."¹

Beginning of Breed Improvement.—The first trace of a deliberate attempt to reduce the size of the pony is found in the interesting notes made by "The Druid," in *Field and Fern* in 1865. This attempt was an integral part of the first recorded effort at breed improvement, which was made at that time by Colonel Balfour, the proprietor of Shapinsay; but on the whole there has, happily, been no very general attempt to exaggerate the smallness which is characteristic of the breed.

It cannot, indeed, be said that any very clear idea of the im-

¹ *Statistical Account of Shetland*, Section "Unst," p. 45. By John and James Ingram. 1841.

provement of the pony has been operative in the Islands. more recent times the influence of shows has made itself felt, and on the whole with advantage; and there has been a steadily increasing tendency to develop ponies with power and weight to meet the demands of English and Scottish buyers who have had in view chiefly the demands of the coal-pits. It must be remembered that the pony is bred in Shetland for export rather than for home use. The provision of roads and the consequent employment of wheeled vehicles has, as already remarked, led to the use of larger ponies; and while at one time considerable use was made of ponies for riding and pack transport, especially for the carrying of peats, this has steadily dwindled, and has now in large measure disappeared. This state of matters makes it inevitable that the Shetland breeder, in so far as he is free to decide the matter, should endeavour to produce the pony that is required for the British market, which is his main outlet. This fact has, on the whole, had a very good effect on the development of the pony in Shetland.

It has, no doubt, tended to encourage a type of pony in which quality and breeding are sacrificed to weight, bone and substance. But it has discouraged the "weedy" and weak and excessively small pony, and it has helped to eliminate the "curbiness" of hocks which was at one time accepted as characteristic of the Shetland pony.

The Londonderry Stud.—This tendency was enormously developed by the establishment, in 1870, by the Marquis of Londonderry, of the Londonderry Stud in the islands of Bressay and Noss. This stud, during the thirty years of its work, ending in its dispersal in 1899, set the standard which governed show-yard decisions for many years and still continues to influence them.

The Stud was founded in order to provide ponies for its owner's coal pits, and its standard was always governed by this object. It has very generally been stated that its aim in pony-breeding was the production of as much weight as could be developed, as near the ground as possible; and this formula, in itself no bad description of one of the characteristics of a good pit pony, summarises fairly well the pure Londonderry type in its extreme development.

The Londonderry Stud rendered incalculable service to the Shetland pony breed by eliminating feeble and weedy animals, defective hocks and unsoundness generally. Its weakness lay in its concentrating too much attention on the qualities desirable in a pit pony and neglecting the qualities essential for other uses—the shoulder, wither and general quality required for a saddle pony—and more generally in sacrificing activity to mere bulk and weight. It also tended to limit the colours of Shetland ponies. Its main lines of breeding excluded all colours except black, brown and occasionally bay; and, while it may be true that the best ponies are now generally of these colours it must be kept in view that other colours—grey, roan, dun and chestnut—are prevalent in Shetland, are found in very good ponies, and should not be excluded from the breed. Mr R. W. R. Mackenzie has recently been engaged in reviving the dappled grey pony with dark blue



Shetland Pony Mare, BOADICEA (998)

[These four blocks illustrating Shetland Ponies have been kindly lent by
the Shetland Pony Society]

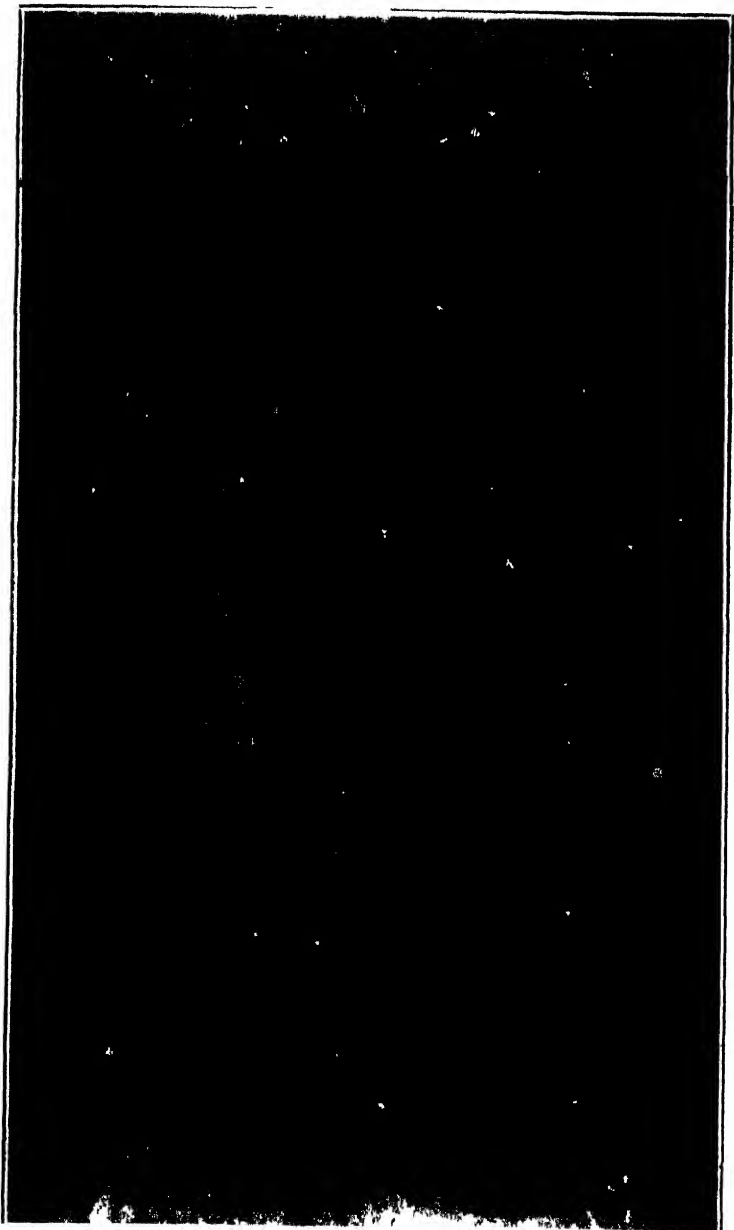


Shetland Pony Mare, SAPHIRI (1276)

1st at Crystal Palace Horse Show 1895

1st at Highland and Agricultural Society's Show at Kels 1896

1st at Royal Agricultural Society's Show at Manchester, 1897



Shetland Pony Stallion, Thor (83)
1st at Highland and Agricultural Society Show at Dundee, 1890

hoofs and has produced a strain of an interesting and distinctive type.

In its main outlines, however, the Shetland pony, as we have it now, is the pony as it was created by selection and inbreeding in the Londonderry Stud; and the present-day breeder cannot afford to neglect, as the principal foundation of his work, the Londonderry strains with the security which they give for soundness, stamina and the likelihood of continuity in breeding results. At the same time he ought not to neglect to seek elsewhere for ponies of evidently pure breeding which excel in those respects in which the Londonderry ponies are defective. The chief of their defects is a tendency to exaggerate stoutness into an unsightly stumpiness, carrying with it shortness of neck, roundness of withers, and large, low-carried heads. These characteristics do not merely involve a loss of symmetry and a dwarfish appearance. They also lead to a lack of activity. In point of fact, many of the Londonderry ponies are sluggish and unsightly walkers, lacking the stride and freedom of gait which every good horse should possess, and the introduction of crosses from Island ponies excelling in this respect is calculated to improve the breed.

If the Londonderry Stud has been the chief formative influence in the production of the present-day pony, the foundation of the Londonderry Stud was the black horse "Jack" (16), purchased as a three-year-old colt by Lord Londonderry in 1874, since he was the sire or grandsire of almost all the stallions bred from in the Stud, as well as of more than half of the mares recorded as belonging to it. Of the 490 foals entered in the *Shetland Pony Stud Book* as the produce of the Stud, 248 are by Jack and three of his sons, and 168 by eight of his grandsons, while only 46 are by sires wholly unrelated to him. On the female side, out of 125 mares entered in the *Stud Book* as the Londonderry breeding stock, 76 are by Jack and his three sons, and 10 are by his grandsons. The degree of inbreeding which this concentration entails is such as to entitle us almost to say that the present-day pony, in its principal development, is the "Jack" pony; this fact makes it the more regrettable that we have no record of Jack's origin and no full description of his appearance. He was a black horse, 40 inches high. The only portrait of him which exists depicts him as a short-backed, close-coupled horse, strong in bone and combining great substance with a bold and upright carriage. His great prepotency as a sire suggests that, like so many Shetland ponies, he was closely inbred. His robust vigour is attested by the fact that, living to the age of thirty, he was at Stud to the end of his life. Among his most famous sons were Odin (sire of Thor and other well-known ponies), Laird of Noss (sire of Harold, Duncan and Hector), and Lord of the Isles (sire of Multum in Parvo).

The only other important element in the Londonderry Stud was that which was contributed by the horse Prince of Thule. This pony, a seal brown in colour, 36 inches high, was the only sire unconnected with Jack which exercised any considerable influence on the Londonderry Stud. He was a pony of very fine quality, with a thoroughbred head and very bold and prominent eyes, short-backed, with rather drooping quarters, strong-boned and

with large joints. He is the source—probably the only source—among Londonderry sires of whatever elements in the modern pony represent the Oriental type, and animals derived from his stock offer the best hope of finding within the Londonderry strains breeding material to correct the defects of the descendants of Jack. The famous horse Multum in Parvo, and the well-known mare Boadicea represent this influence at its best.

The Modern Pony. — The Shetland pony continues, in his modern development, to be marked out by his small size. The *Stud Book* limits the size of ponies for registration to 42 inches, and it is probably not advisable to modify this restriction, since an increase above this limit would alter a fundamental breed characteristic. At the same time it must be pointed out that present show-yard tendencies are proceeding dangerously to an opposite extreme. The breed in the show-yard becomes progressively smaller; animals approaching 40 inches in height are sedulously discouraged; and favour is often shown even to those less than 34 inches. Now, while it is quite true that there have been admirable ponies of 34 inches and even smaller heights, there are serious objections to a general tendency to aim at producing them. The fundamental objection is that they are useless, and that to aim at the production of animals which are useless is to level the deadliest of all blows at the breed to which they belong. No race of horses will continue to be bred if its members, when they miss show-yard honours, are without a function and a value, and those who disregard a commercial criticism of this kind, however enthusiastic they may be, are the worst enemies of the breed. Now the fact is that there is not and never has been a commercial demand—as distinct from a curiosity demand—for these excessively small ponies, and the reason is that they are not useful. They are not, if they are reasonably well-proportioned, likely to have the weight and substance that will fit them to draw loads; and they are of necessity too short in the arm to make good riding ponies, since the cannon bone cannot be indefinitely shortened. They will never compete in the market with animals built on a more useful scale.

But further, the excessive reduction of size that is now encouraged is not, on the whole, compatible with the highest symmetry, since that very shortening of the arm, which has just been referred to, is an essentially dwarfish characteristic and makes the pony more or less of a freak. A Shetland pony ought to be as symmetrical as a good hunter or Clydesdale; and in order to bring about this result generally the pony should be bred as nearly as may be at his “natural” height—the height at which he will most generally attain his proper symmetry. This is not, in point of fact, the least height to which he can safely be reduced. It will be found generally by an examination of the records of the best specimens of the breed that a large proportion of them have been of a mean height of about 38 inches, and that few useful breeding animals have been below 36 or 37 inches, just as few have been over 39 or 40. Ponies outside a range of sizes from 36 to 40 inches should be discouraged in the show-ring, unless they are

otherwise of great merit; and those below the lower limit, in particular, should be regarded with extreme suspicion.

Another of the earliest marked characteristics of the Shetland pony in his native islands should also be carefully safeguarded by the present-day custodians of the breed. The "mettle past belief" that early travellers saw is the hall-mark of robustness and hardihood, and when the pony loses these he ceases to be himself. He has his quiet times and he can learn the most profound sedateness, but he must be full of spirit and vitality, and this is a quality that must be guarded with constant vigilance in the case of an inbred animal, especially when anything is done to relax the severity of the conditions under which it lives. A soft, sluggish or lethargic mien is the first warning of danger, and should not be disregarded. Soundness is, of course, essential in the Shetland pony, and it is rarely lacking—bone defects being almost unknown. But spirit and vitality are not less essential.

The Points of the Shetland Pony. - It may be permissible to reprint here a general description of the points of the Shetland pony, published a few years ago:

"The general symmetry of all good horses is very much the same; and the Shetland pony is no exception. But, in particular, he should be deep through the heart, short and strong in the back, well ribbed up, and well sprung in barrel. The shoulders should be long and well sloped, showing sharp and distinct withers. The quarters should be broad and long, and well filled up, with the tail set high and carried gaily. The neck should be long, well arched, and powerful, fine at the gullet, and carrying the head high and well forward."

Perhaps in no point is the present-day Shetland pony so often defective as in shoulder. Many of the most substantial and characteristic ponies of the "Londonderry" strain are short and straight in shoulder and wholly lacking in withers. Such ponies as these may be useful in the coal-pits, but they are useless above ground. They can never be really fine and active movers; and they can never be—what the Shetland pony ought to be—the child's riding-pony. Shoulders and withers that will hold a saddle should be regarded as a *sine qua non* of a really good pony. In this respect much yet remains to be done in the improvement of the breed. In other directions great advance has been made and long backs, flat sides and short and drooping quarters are less in evidence every year. The general style and symmetry of the pony are steadily improving.

Nothing in the proportion of a pony more affects his appearance than the size, form and carriage of his head. Undoubtedly many of the most massive and powerful of present-day Shetland ponies are disfigured by heads which are not merely out of proportion to their size but which are also carried much too low. This last defect commonly arises from and goes with defective shoulders; but, from whatever cause it proceeds, it must be regarded as a most serious blemish, fatal alike to the appearance of the pony and to his safety and pleasantness as a mount. To eliminate it from the breed without sacrificing the substance and power with which

it is often associated may be a matter of skill, time and patience, but breeders ought not to be satisfied until this object has been attained.

The head itself should be small and short, wide across the forehead, relatively long from ear to eye, with a muzzle short and fine and somewhat hollowed, or almost "dished," immediately below the eyes, which should be large, full and prominent, looking well forward, so as to be clearly seen from in front. "Ringle" or "wall" eyes are a serious though not a common defect, and should be discouraged. The ears should be small and erect, wide set, but pointing well forward, the nostrils wide and open. The shape and carriage of the head are even more important than its size.

It is perhaps in limbs and joints that the modern pony marks the largest advance upon his unimproved Island forefathers. Reference has already been made to the apparent "curbiness" of the hocks of many Island ponies. This is a defect that has very largely been bred out of the Londonderry strain, in which good joints, and particularly good hocks, have, with occasional exceptions, no doubt, become well established. Strong and muscular limbs should characterise the Shetland pony—long and powerful forearms and thighs, large, low-set knees and hocks, flat and clean bone below them, and fairly long pasterns. A common fault in some strains is lack of muscle in the second thighs, which is often so exaggerated that the pony has the appearance of having a deep hollow behind the thigh instead of an easy line from the quarters to the hocks.

On the whole, the feet of the Shetland pony are good—large, round and open, of fairly hard and very sound texture. Occasionally, however, narrow and contracted feet are found, and these should be regarded as a serious defect.

The coat of the pony is one of its most familiar and characteristic peculiarities, consisting as it does of fine thick fur below and an outer covering of longer and harder hair growing through it. Any weakness of coat is a serious fault, not only as being a departure from a deep-rooted characteristic of the breed, but also on the most practical grounds. No better protection could be imagined against wind and rain than the thick undercoat, waterproofed by the outer hair, from whose damped locks the water drips along the pony's sides, while the under parts of the body remain dry and warm. In summer the shaggy coat, falling off in ragged masses, is replaced by a sleek and fine hair. At all seasons the tail, mane and forelock are as picturesque as they are useful in protecting the pony against weather and flies. They should be abundant, the hair strong in texture and straight, falling flat, and, like the foot hair, free from any tendency to curl. It is an interesting characteristic of the Shetland pony that many animals shed in autumn the upper lock of the tail in such a way as to look as though the hair had been scrubbed off, although on actual examination it will be found that the hair is cast from the root and grows in again. A similar appearance is undoubtedly represented in prehistoric horse portraits.

All colours are permissible in the Shetland pony, although black and dark brown are now most common and are preferred in the

Islands by the oldest traditions, which associate piebald and skewbald colours with softness of temper and with a strong suspicion of Norwegian cross. White markings in ponies other than piebalds and skewbalds are an undeniable blemish, particularly if they take the form of white stockings and the accompanying white hoofs. Dun, grey, roan and dappled grey are good colours which should not be allowed to die out; the dappled grey should have blue hoofs.

Action is increasingly regarded, and rightly so, by judges in the show-yard, and it is of the utmost importance in practice. It should, of course, be perfectly true and straight: dishing, straddling and wide hock action are glaring faults. But action should also be vigorous, light and springy, not showing the roundness that often disfigures hackney gait, but with forelegs well thrown forward from the shoulder both in walking and in trotting, while knees, pasterns and hocks are freely and powerfully flexed. It must be admitted that in many Shetland ponies activity has been unduly sacrificed to abnormal shortness of limb. This is a point which demands careful attention, and it may be worth while to note that the ponies in the Islands are, as a rule, singularly active, as indeed the conditions of their existence require that they should be.

In one other respect modern show standards and conditions threaten rather to impair than to improve the breed. The appearance of the pony in the Islands almost invariably suggests a strong and vigorous frame; in the show-yard there are few ponies whose appearance suggests any frame at all. This is, no doubt, greatly aggravated by the extreme and excessive fatness of most ponies in the ring, but it points to a real defect also. Every good horse ought to suggest to the imagination the general structure of his bony framework, and it ought scarcely to be possible to conceal this by any reasonable degree of condition, or to bring about in a horse a general appearance of bonelessness such as might be proper to the carcase of a perfectly fattened Aberdeen-Angus bullock. Partly from the practice of showing ponies much too fat, and partly also from the fact that breeders have neglected to seek for strength of frame as distinct from mere thickness of bones, the Shetland pony in the show-yard has undergone some little deterioration in this respect. It should not be forgotten by breeders or judges that a pony whose shoulders, hips and stifles are not prominent in his appearance is either defective in structure or very improperly overfed." ¹

The Pony as a Farm Animal.—The pony has always been an increasing source of revenue to the Shetland crofter. In 1845 the Statistical Account values ponies at from £1, 10s. to £5. Twenty years later "The Druid" estimates the value of horse ponies at £7 and of mares at £5. In 1871 Cowie states these values at £8 to £10 and at £5 respectively. In the year 1913 good stallions easily commanded prices over £20 for pit work, and at this price, in view of their small cost of production, ponies must have been a very profitable class of stock. During the war Shetland ponies—

¹ Douglas, *The Shetland Pony*, pp. 70 ff. Blackwood, Edinburgh. 1913.

alone among horses—declined in value and became almost unsaleable; but demand for them revived immediately after the Armistice, partly on account of the lack of Russian ponies for pit work, and at the present moment any useful horse-pony not less than ten hands high, over three years old, is worth from £30 upwards.

No animal is more easily reared than the Shetland pony. The mares ought, indeed, to have reasonably good grazing while their foals are dependent on them. But at other seasons of the year even they are unexact, and other ponies require nothing more than hill grazing of the roughest kind, except in the case of foals, which, after they are weaned, between October and December, ought to receive a little hay and bruised oats till spring. All ponies should have a little rough hay when snow is on the ground.

The mares breed practically as a wild herd. The stallion should run loose with his herd of mares, from the beginning of June for about three months, so that the foals may be born from May onwards and be weaned in time to allow their mothers four or five months' respite before foaling begins again.

Each spring the foals of the previous year may be put to graze with the two and three year old ponies of the same sex. At three years old fillies may, if desired, be put to the stud, and colts are available for breaking and work. The coal-pits absorb a considerable number of strong stallions, while others are used as children's riding-ponies, work for which they are admirably fitted by their singular docility and sweetness of temper. There appears, on the whole, to be a considerable field for the employment of the smallest and not the least attractive member of the equine race.

COMMON WEEDS.¹

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V.—WEED CONTROL.

WEED control is simpler for annuals than for perennials. If the seedlings of annuals or young perennials are well buried they have little power of recovery, and as their root-system is mainly near the surface the plants can be uprooted and left to wither. Perennial weeds are less easy to bury or to uproot, and often require special methods, which will be indicated later when these weeds are described. For annuals the ideal to aim at is the prevention of seeding, then the destruction of seedlings, but the problem is how to fit the necessary operations into the details of crop management.

Prevention of Dissemination.—Most of the weed-plants that appear in a field have come from seeds or underground parts already in the soil. The natural agencies for seed dispersal bring few weeds to the land compared with the various modes of dissemination brought about by man. There must always be some

¹ This is the third instalment of this article, which will be followed by articles dealing with other farm pests

seeds blown by wind or carried in various ways by birds and other animals, and the risk from these is increased where weeds are allowed to seed in the neighbourhood, but the great centre for seed dispersal is the farm-steading. As already indicated (Jan. 1921, p. 14), the main sources are farmyard manure, threshing-mill screenings, hay-loft sweepings and impurities in seed used for sowing. The large amount of transport on a farm gives ample opportunity for seed dispersal from farm-buildings to the field, and even from field to field.

(a) Farmyard manure that is well rotted contains the least number of living weed seeds, but numerous observations prove that the oldest manure may still carry them. Weeds like fat-hen, knotgrass and chickweed quickly spring up where there has been a "muck-heap" in a field, and where they must have undergone prolonged fermentation. How the newer manure can be disposed of will depend on the cropping of the farm. If it cannot be left to rot, then the safest crop to apply it to is old grass, because there the ground is covered with herbage, and there is not so much room for seedlings. There is also the chance that grazing will keep the seedlings from flowering. The next option is a root crop, but as this is intended to allow the land to be cleaned, then the fewer new weeds the better. If, however, the suspected manure were put on definite drills, more frequent working of that part could be done. The same extra cultivation should be given where there has been a "midden" in the field.

(b) Threshing-mill screenings, and sweepings from hay lofts and stackyards, contain so many weeds that their disposal is not easy. Poultry may take their share, but many weeds still remain. Much of this stuff finds its way into the manure yard, but as there is no certainty that the seeds will be killed, this does not seem advisable. The ideal plan would be to burn all screenings and sweepings, but, as a rule, the equipment of a farm does not include a suitable furnace. There could, however, be a special "dump," and as this would not be large, it could receive special attention from time to time. Some could be burned, if the "dump" were in a safe place, the rest being left to natural fermentation and heating. Destruction would be assisted by a liberal dressing of lime or gas lime. This heap would require to be turned occasionally to prevent it becoming a breeding ground for more weeds. The manurial value of the "dump" after rotting should be considerable, because weed seeds contain nitrogenous substances and oil, often in considerable quantity.

(c) At first sight the small proportion of weed-seeds occurring as impurities in grain or other seeds sown on the farm may appear to be of no consequence. What one per cent. of impurity means in actual numbers has been shown for several common weeds in an earlier volume of this *Journal* (vol. i., p. 191, April 1918). One per cent. by weight of geranium in white clover means about 3750 seeds in every pound of clover; 1 per cent. sheep's sorrel is 12,600 seeds per lb., and 1 per cent. *Agrostis* is 40,500. The same source, the Scottish Seed-testing Station, has supplied for use here the following details referring to well-known varieties of white oats sent for reports. The total for each column is the number of seed

impurities actually found in each sample, but for comparison these have been raised to the number per lb. The weeds named are arranged in the order followed in previous pages, except wild oats.

Sample.	I	II	III	IV	V	VI	VII
Wild Oats	1	...	38	50	...	...	...
Charlock ... ..	...	5	25	...	52	438	480
Runch	2	3	...	32	7	...	...
Corn Marigold ... ..	...	...	...	...	12	...	...
Spurrey	1	5	1	13	49	...	4
Knotgrass ... ..	...	6	5	2	1	80	2
Redshank ... ..	...	...	2	224	13	...	4
Bindweed	5	49	6	14	39	4	81
Hemp Nettle ... ..	...	...	...	25	7	...	4
Fumitory .. ..	...	...	1	...	15	...	9
Corn Pansy .. ..	...	...	...	...	2	...	30
White Goosefoot .. ..	...	...	...	...	218	...	18
Fat-hen (Orache)	16	2	1	...	75	42	111
Other Weeds	3	3	1	9	...	11	35
Black Oat, Barley, etc.	5	27	23	4	...	4	...
Ryegrass	5	...	20	...	1	...	...
Total in sample	38	100	123	373	491	579	778
„ in 1 lb.	68	105	207	437	827	686	889

If oats are sown at 6 bushels, of 42 lbs. per bushel, that is about 250 lbs. per acre; then 100 weeds per lb. means 25,000 weed seeds per acre. The higher figure, nearly 900 seeds per lb., means about a quarter million weed seeds per acre, or 1 weed seed for every 12 oat grains, if the number of grains per acre be taken at three millions. A glance at the names of the weeds will show that the seeds are all from vigorous annuals found on most farms, and it may be assumed that a large proportion of the weed seeds would give rise to seedlings if sown.

Destruction of Weeds by Ploughing.—The general turning over of the land between harvest and sowing time clears away all annuals except for seeds in the soil. To keep the land clean most of the year requires the ordinary field implements, used in the right way and at the right time. So far as weeds are concerned, early ploughing is to be recommended. There is a tendency to leave the land for root crops too long, so that precocious weeds flower and seed in the early months of the year. Where any field needs cleaning, every effort should be made to turn it over early. If the weed growth is strong and branching, as with knotgrass and yellow weed, a preliminary harrowing and burning might be considered. Deep ploughing is better than shallow, as it ensures a deeper burial of the surface growth, while it also brings up the roots of deeper weeds. The following example is on record. Part of a weedy field was ploughed about 5½ inches deep, another part 12 inches. In a short time the shallow-ploughed soil began to show green growth, whereas the deeply-ploughed part remained longer black. In April a weed-count was made, which showed 58 weeds per square yard on shallow, as against 5 per square yard on

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deeply ploughed, ground. The appearance of new plants during an open winter after early ploughing is no disadvantage, because they will all be destroyed by the later cultivation before sowing, generally before any weeds have time to flower. The late-sown turnip crop thus offers a good opportunity against weeds. The fallowing of land is not often seen now, but in exceptional cases it may be used, more especially to clean out deep-rooted perennial weeds. Fallowing is of no use unless the land is thoroughly worked, so that each generation of new plants is destroyed while still young and tender.

Cleaning of Land under Crop.—The cereals offer less opportunity for cleaning land than do root crops. The earlier sowing means that fewer weeds are killed, and as the land is soon covered operations are limited. Yet in a vigorous campaign against weeds, cultivation may be carried on till the cereals are about six inches high. With drilled corn it is possible to stir the soil with fine-toothed cultivators, such as the American weeder¹ and the poppy killer.² Autumn-sown wheat requires some attention in spring because weeds, such as speedwell or mother of wheat, weed grasses, and cleavers,³ can grow during the winter when the ground is ill-covered by the young wheat.

The advantages of root-crops in suppressing weeds are too well known to need repetition. The thorough working of the soil for turnips till late in the season is all in the right direction. The Continental method of cultivating sugar beet entails deep cultivation and frequent hoeing, but the cleaning of the land lasts for several years. In the case of potatoes, the following effective method is now fairly common; two or three weeks after planting, the first drills are harrowed down, and the soil between the drills is deeply worked with a grubber; new drills are moulded up, sometimes to be flattened out again before making up the final drills. Later cultivation between the drills, earthing up, and hand-hoeing between the plants completes a fairly thorough campaign, especially if carried on till the leafy tops are dense enough to shade the ground and any later weeds that appear. The weak spot in potato cultivation comes later in the year. This is recognised by early potato growers, who, within a few days of clearing the crop, sow out a catch crop of ryegrass, rape, barley or oats. The advantage gained in keeping down weeds is just as great as any direct financial return from the catch crop, and the later grazing off with sheep is a good check to most weeds preparing to flower. The second early potatoes with haulms that die down early offer a long period of weather favourable for the growth of weeds. As a rule nothing is done, nor is it always easy, but it is a great chance for annual weeds to mature seeds, and it offers an opening for the enterprising weed-killer. Wheat often follows potatoes, and the prevalence of certain weeds in wheat, in spring, has already been pointed out.

Smother crops, such as tares, vetches, peas, oats and rape are intended to cover the land so closely that few weeds can live

¹ Illustrated in *Farm Weeds of Canada*, 1909.

² Illustrated in *Common Weeds of the Farm*, H. C. Long, p. 35.

³ See *Weeds of Farm Land*, W. E. Brenchley, p. 174, etc.

beneath them. As a rule they are grown in special cases, such as on cleared manure heaps, potato pits, or other much-disturbed places where weeds are likely to flourish. If vigorous and quick-growing plants are used and sown thickly, they are generally effective. Thickly-sown grasses and clover act to some extent as smother crops, especially a mixture of Italian ryegrass and clover or clover alone, for one year's hay.

Effect of Rotations on Growth of Weeds.—The results of growing the same crop for years have been observed at Rothamsted. The field where wheat has been grown for seventy-five years is infested with black bent-grass, the barley field with sow-thistle, whereas the continuous "roots" field carries few weeds. The newer work at Rothamsted has shown an interesting relation between certain weeds and particular crops.¹ This suggests the possibility of checking some noxious weeds by changing the rotation. How it is to be done must depend on the kind of farm, but the following are suggestions: the shortening or lengthening of the grass break, or the time between grass and grass; two root-crops in succession; or potatoes on the turnip break, or turnips instead of potatoes on a "potato farm."

Chemicals as Weed Killers.—(1) Copper sulphate has been tested extensively. The usual rate is 4 or 5 lbs. in each 10 gallons of water (4 or 5 per cent. solution) applied at the rate of 40 gallons per acre; 50 gallons of 3 per cent. solution has also been found effective. The sprayer consists of a force pump, a tank or barrel, and a set of nozzles capable of throwing a fine misty spray downwards. The most favourable weather conditions are a calm day, to ensure even spraying, followed by sunshine and dry air; the result is that the plants turn black in a few days. The following seems a fair statement by a pioneer of charlock spraying,² and has been confirmed by later experience:

- (a) Charlock can be destroyed in growing corn crops, without permanent injury to the latter, by spraying with fifty gallons of 3 per cent. solution of pure sulphate of copper per acre.
- (b) Generally the corn crops are much improved and give a better yield where charlock is destroyed, and young grass seeds and clover in the corn remain uninjured.
- (c) Spraying early when the weed is young and in soft fibre is more successful.
- (d) Larger sprayers are more successful than the smaller.
- (e) The profit of the operation is diminished in proportion to the delay which occurs after the charlock is in the most suitable condition.
- (f) The increased yield of corn leaves a profit after all the expenses of spraying have been defrayed, and the annual value of the land will increase. Charlock and runch are destroyed if not too dense. Spurrey and redshank are more resistant and require stronger solutions. Poppy requires two sprayings. Several other weeds are

¹ W. E. Brenchley, *Weeds of the Farm*, chap. x.

² G. F. Strawson, *Standard Fungicides in Agriculture*, 1903.

damaged enough to interfere with flowering. Corn and clovers are generally damaged, but renewed growth follows from new leaves.

(2) Iron sulphate may be used if it is cheaper than copper sulphate. Forty gallons of 7 per cent. (7 lbs. in each 10 gallons water) have been found to kill charlock in oats, but strengths up to 15 per cent. have been used, and damage poppies and buttercups. The spraying and weather conditions should be the same as for copper sulphate.

(3) Dry sprays of finely-ground kainit (6 to 12 cwts. per acre), and calcium cyanamide (60 to 100 lbs. per acre) have been found seriously to check the growth of charlock, runch, and other weeds. A better result was obtained on plants wet with dew. If further experiments should confirm these results, it is a recommendation that these substances are plant manures.

(4) Some weeds (*e.g.*, sheep's sorrel, sorrel, spurrey, corn marigold and red shank) are indicators that land is deficient in lime. Recent experiments at Rothamsted show that both sorrels actually grew stronger with abundant lime than with little or no lime. This indicates that the above weeds are not necessarily lime-shy, but on soils poor in lime they can endure the conditions better than most weeds. On land richer in lime or basic substances, other weeds grow stronger and take first place. As soils poor in lime are generally acid, and do not have the highest fertility, the presence of the above weeds should be taken as a hint that lime or some basic manure is needed, partly to remove the weeds, but mainly to improve the fertility for useful crops. The amount of lime necessary to suppress spurrey and sorrel quickly, as found by experiment, is too high for successful crop-growing, hence liming should be begun gradually and continued through several rotations.

Treatment of Hedge-Bottoms and Field Margins.—One method is to turn these over regularly so as to destroy all plants, but as annual weeds soon appear again, the process will require to be repeated several times a year. The other method, which has points in its favour, is to leave the herbage that cannot be reached by the plough. If let alone, this will consist almost entirely of perennial grasses and weeds that flower once a year, or at most twice. Cleaning operations will consist in cutting before flowering, about June, and where possible drying and burning the herbage. Another cutting later would dispose of late flowers, and any extension of the hedge-plants into the field by runners would be checked each time the plough was used.

Treatment of Perennial Weeds.—The general treatment in mass suitable for annuals does not always apply to perennial weeds that have passed the seedling stage. The adult plants last for years, and have special devices for growth and propagation, and on the nature of these depends the line of treatment. Special methods will be given later along with descriptions of some common perennial weeds, but some general measures may be indicated here.

The outstanding feature of perennials is that there is a supply

of winter shoots which keep the plant green during winter, or there are winter buds that throw up new shoots in spring. These buds may be found in a close tuft or mat, sometimes at the top of a thick tap-root (dandelion and dock), or they may arise on creep-



FIG. 14—PLANTS COMMON IN TRODDEN PLACES.

(A) Broad-leaved Plantain (*Plantago major*); (B) Silverweed (*Potentilla anserina*); (C) Rough-stalked Meadow-grass (*Poa trivialis*).

(Weeds of Farm Land, W. E. Brenchley.)

ing runners or suckers (Fig 14). In devising methods of treatment, it is important to observe the position of the winter buds, because the plant may be propagated much more from them than

from seeds. The following groups include most of the commoner perennials:—

(a) *Tufted weeds with no runners or very short ones.*—The plant consists of a crown bearing leaves and buds, while underground numerous fibrous roots arise from a short rootstock (Fig. 14—Plantain). Some examples are daisy, yellow ragwort, hard-heads and buttercups (except the creeping buttercup). The biennial spear-thistle is a plant of this kind, which forms large rosettes of leaves one year, flowers the following year, then dies away, whereas the smaller-headed field thistle is a true perennial, with numerous wide-spreading underground stems and roots. These tufted weeds are uprooted during cleaning operations on arable land, and they dry up and die if completely turned out of the soil. Grassland is more favourable to them because it is less disturbed, and unless there is a strong growth of grasses and clovers these weeds may become established. Grazing checks the tufted weeds, especially at times when the pastures are closely eaten down. Sheep nibble closely into the crowns of ragwort, spear-thistle, plantains, hard-heads, and ox-eye daisy, hence these are not so common in sheep pastures as where cattle graze alone.

(b) *Tufted weeds with deep rootstocks, such as dock, dandelion and sorrel.*—The buds are buried deeper in the soil than in the previous group, and if the crown is simply bitten over by grazing, or cut by shallow spudding, the result is a dozen or more of new crowns. Complete treatment means thorough turning out of the rootstocks, either by deep spudding or by ploughing or deep cultivation. Unless the weather is dry when the crowns are turned out there is considerable risk of them rooting again because the fleshy rootstocks take some time to dry, and then it is advisable to collect and cart them off the land.

(c) *Tufted weeds with runners.*—Creeping buttercups and silver-weed (Fig. 14, B) spread entirely by surface runners that root at the nodes and form new plants. Creeping bent or florin grass and rough-stalked meadow grass (Fig. 14, C) throw out numerous surface shoots and in arable land may become weeds. Sheep's sorrel and self-heal have surface runners as well as underground suckers. The surface-rooting habit of these weeds renders them fairly easy to uproot in arable land, hence they are usually found mainly about gates and round the edges of a field. In grassland they may become abundant, more so with cattle than with sheep-grazing; where too abundant they generally indicate impoverishment and the need of ploughing up, followed by cropping to increase fertility.

(d) *Creeping weeds with deep underground parts.*—This group includes the most obstinate weeds of the farm, e.g., coltsfoot, creeping thistle, creeping sow-thistle, field convolvulus, bishop-weed, field mint, couch grasses, horsetail, and bracken. The parts bearing buds are often deep in the soil, and the creeping underground stems are rather thin and brittle, so that, during cleaning operations on arable land, fragments are left in the soil ready to produce more shoots. Eradication needs thorough ploughing and deep stirring to break up the older plants and bring them to the surface for harrowing. Shallow ploughing fails to do this, and the

creeping stems can be seen, below the plough sole, lying quite unharmed. After the first ploughing and harrowing, frequent cultivation is required, as in root crops, to dislodge growing fragments from the broken-up plants. Some of these weeds (coltsfoot, sow-thistle, field convolvulus, field mint and couch grass) are rarely seen in quantity in old grassland, hence they may be suppressed by putting the land under grass for a time, provided a strong growth of grasses and clovers is maintained. On the other hand, field thistle, nettle and bracken are favoured by grassland, unless kept down by repeated mowing, say three times a year, to prevent flowering and to starve the underground parts.

THE GRADING OR CLASSIFICATION OF MILK.

WILFRED BUCKLEY, C.B.E., *Chairman of the Council
of the National Clean Milk Society.*

MILK, as it reaches the consumer, varies in its chemical composition and in its hygienic quality. Upon these two factors depend the actual value of milk to the consumer and, to a certain extent, the cost to the producer and to the distributor. It is to the mutual interest of the buyer and the seller (*i.e.*, the consumer, the producer and the distributor) that there should be some means whereby its relative value can be recognised, as is the case with almost all other commodities, or, in other words, that milk should be graded or classified by some reliable body or authority that commands the confidence of both parties to the transaction.

Relative Values of Milk.—The grading or the classification of milk implies that milk as it is offered for sale to the consumer should be so described that the purchaser may know exactly what kind of milk he is actually getting; as has already been said, the value of milk depends on two separate factors—its chemical composition, and its hygienic quality. Therefore, if possible, any designations used should convey to the purchaser accurate information in regard to these two points. Let us now consider these two factors separately and determine to what extent it is possible to define them when classifying milk.

Chemical Composition.—For practical purposes the chemical constituents of milk are divided roughly into three parts: fat, solids other than fat, and water. It is the relative variation of these three parts that affects the value of milk so far as its chemical composition is concerned. The average sample of cow's milk contains about 3·5 per cent. of fat, 8·75 per cent. of solids other than fat (or a total of 12·25 per cent. of solids), and 87·75 per cent. of water. The percentage of solids other than fat varies comparatively little. Under normal circumstances an increase or a decrease of about 5 per cent. from the average amount (above

9.25 per cent. or below 8.25 per cent.) is unusual. Such a variation is not of much consequence; therefore in the classification of milk for commercial purposes there is no need to consider the amount of solids not fat that it contains.

The fat percentage presents a totally different problem. Its variation is of very great importance, for not only is a given weight of fat of more value than the same weight of solids other than fat, but the variation between different samples is very large—a sample of the milk from individual cows may contain even less than 2 per cent. or more than 8 per cent., and that from herds may vary between 2.75 per cent. and 5.5 per cent. (a difference of 100 per cent.), or even greater extremes. It is evident therefore that, if it is possible, the fat content should be taken into consideration in any complete system of classification. The percentage of fat in milk is dependent on various factors: the breed of the animal, its strain, the variation between hours of milking, the length of time that has elapsed since calving, etc. (It is not dependent, as is frequently stated, on the foods that the animal consumes, provided it gets enough of the right food to keep it in health.)

Let us assume that milk is to be classified, in part, on the basis of its fat content, and that instead of a maximum and minimum percentage being specified for each grade (which would be advisable, especially in the case of milk wanted for infant feeding), the only requirement pertaining to fat is that it shall not fall below a stated percentage.

Clearly, all milk must contain not less than the amount of fat specified for its grade: it would not be sufficient for the purchaser to know that a given grade usually, frequently or sometimes contained, or might be expected to contain, a certain amount of fat. The purpose of classification would not only be defeated, but its application would be actually misleading unless all the milk sold under a particular designation conformed to the specified requirement.

What steps could the producer take to ensure a minimum fat content in excess of the present legal minimum of 3 per cent.? The average Channel Island animal will give throughout a period of twenty-four hours a higher percentage than the average Shorthorn, Ayrshire or Holstein, but individual animals of the latter breeds may give better results than individuals of the former—so neither the producer nor the grading authorities could depend upon the breed. Further, in any single herd the fat content in the whole of the milk produced in a period of twenty-four hours will vary largely. In my own herd of 63 Shorthorns I found the following variations during thirty-nine consecutive days: maximum, 3.82 per cent.; minimum, 3.28 per cent.; average, 3.48 per cent.; during which period the morning figures were: maximum, 3.50 per cent.; minimum, 2.77 per cent.; average, 3.08 per cent.; whilst those for the afternoon were: maximum, 5.07 per cent.; minimum, 3.68 per cent.; average, 4.11 per cent. Again, the percentage of fat content of the morning's milk is invariably lower than that of the evening's milk, even if the animals be milked at equal intervals of twelve hours; such intervals are impossible on the average farm, fifteen and nine hours being the usual periods, in

which case the evening's milk will usually be found to contain about 1 per cent. more than that of the morning. It would be equally futile to attempt to put the animals in any herd into groups, for the milk from almost every cow varies in fat content, not only owing to the length of time that has elapsed since calving, but from day to day. I have known a healthy Shorthorn give 11 pints of milk, containing 2.2 per cent. of fat, on one morning, and on the next to give a similar amount containing over 4 per cent., and to give 9 pints containing 6.4 per cent. of fat on one evening, and 11½ pints containing 1.8 per cent. of fat on the following morning. The surest means to provide milk with the least variation in butterfat would be to mix the morning's and evening's milk in one vat, which would be impracticable as well as undesirable, owing to the resulting delay and the damage to the hygienic quality of the milk; the next best method would be to mix all the morning's milk and to mix all the evening's milk, but this would also be impracticable and undesirable, especially where the milk is bottled on the farm.

The only sure means of determining the percentage of fat in all the milk sold is to test the contents of every vessel sent away from the farm, which would be quite impracticable, especially in the case of bottled milk. Even if such a course were practicable, the distributor purchasing from the producer would never know until he actually received the milk to which grade it would belong, and it would be impossible for him to attempt to regulate either his purchases or his sales of any particular grade.

If the classification of milk is to depend in any way upon the fat content, the fat content must be regulated by the addition or abstraction of fat by the distributor. Only the large distributors would be in a position to do this, it would always require extra time and expense in handling the milk, the milk would be damaged, and it would be extremely undesirable. I can conceive of no way in which it would be possible for the fat content of milk to be taken into consideration by authorities when classifying milk.

Hygienic Quality.—This depends upon the number and the kinds of micro-organisms that the milk contains. As milk is drawn from a healthy cow it contains a negligible quantity, as it reaches the consumer it may contain comparatively small or large quantities of micro-organisms that may be pathogenic (disease-bearing) or non-pathogenic. The common forms of pathogenic bacteria found in milk are those producing septic sore throat, scarlet fever, diphtheria, typhoid fever and tuberculosis. The most usual and the most easily controlled from an administrative point of view are tubercle bacilli, producing tuberculosis in man. Raw milk can be divided, primarily, into that which comes from a herd that contains no animal that reacts to the tuberculin test, and that which comes from other herds. The presence of large numbers of non-pathogenic micro-organisms is a menace and a danger to the health of the community, as, when consumed by infants or young children, large numbers of micro-organisms may and very frequently do, set up intestinal disorders that result in illness or in death. Further, large numbers of micro-organisms

have two evil effects: they change the chemical composition of the milk, and they create toxins which cannot be destroyed or their effects counteracted. The quantity of bacteria that milk contains depends upon the means of its contamination, the temperature at which it has been maintained, and upon its age. The determination of the number is the surest practical method of indicating its hygienic quality, as well as the amount of care with which it has been produced and handled.

II

Method of Classification.—I have attempted to show that, in classifying milk, in my opinion it is not possible to deal with its chemical composition, and that its hygienic quality is the only aspect that can be dealt with. This also is the most important aspect. Little variation is found in the solids other than fat. The quantity of fat contained is of importance: a much more serious consideration, however, is the possibility of disease being conveyed or caused by the consumption of unwholesome milk. I have suggested that the best means of classifying milk is to determine the possibility of its containing tubercle germs and the actual number of micro-organisms it contains. The next question to consider is how this shall be done. Clearly the point of importance is the condition of the milk when it reaches the consumer, and not merely that in which it leaves the farm. The score-card system of dairy-farm inspection is of very great value inasmuch as it is a means of educating the producer (as well as possibly the inspector) as to the best methods to be employed, but the score awarded cannot be depended upon in the least to correspond with the bacterial content of the milk. It is essential that the bacterial content be ascertained by the examination of milk obtained at or after leaving the premises of the distributor, at any time before reaching the consumer. Incidentally, the examination of the milk supplied in our large cities can be carried out not only far more efficiently, but with far less expenditure of money than the examination of farm premises. Examinations of farm premises are not usually of much service, they are very infrequently made, and the visits are rarely made at milking time, the fact that the production of clean milk depends far more upon methods than upon equipment being ignored, even if it is recognised, by the inspectors. The examination of cattle by duly qualified veterinary inspectors is another subject.

In regard to the actual grades for application in large towns I should advise the following:—

Certified Milk.—Raw milk, from herds that include no animal that reacts to the tuberculin test, bottled on the farm where it is produced, and containing not more than 10,000 bacteria to the cubic centimetre at any time before reaching the consumer.

Grade A, pasteurised.—Pasteurised milk bottled before leaving the distributor's premises, and containing after pasteurisation not more than 30,000 bacteria per cubic centimetre at any time before reaching the consumer.

Grade A, raw.—Raw milk from herds that include no animal that reacts to the tuberculin test, bottled before leaving the distributor's premises and containing not more than 100,000 bacteria per cubic centimetre at any time before reaching the consumer,

Grade B.—Pasteurised milk bottled before leaving the distributor's premises, and containing after pasteurisation not more than 200,000 bacteria per cubic centimetre at any time before reaching the consumer.

Grade C.—Pasteurised milk to be offered for sale for manufacturing and cooking purposes only.

Except in the case of Certified Milk, special permission could be granted for the delivery of milk in bulk to hospitals or to other purchasers of large quantities, in suitable receptacles other than bottles.

The Ministry of Health and the Scottish Board of Health should be required by Parliament to draw up a scheme of classification, which might be put into force by any Local Sanitary Authority desirous of doing so, in regard to all milk offered for sale within its area.

III

The Effect of Classification.—Classification would bring home constantly to all consumers that there are different qualities of milk. Everyone would wish to obtain the best that they could afford, and as distributors consequently would wish to offer for sale the best milk they could, they would discriminate when buying from producers. In this way the general apathy that exists at present in regard to the quality of milk would no longer exist. Producers and distributors would learn that the production of cleaner and more wholesome milk is much more a question of methods than of equipment, and in a short time the quality of the milk the masses receive would be improved vastly. In New York when the authorities first classified milk 40 per cent. was Grade C, whereas within eighteen months that quality had ceased to exist. I have no doubt but that classification would lead to similar results here. As all milk would command a price commensurate with its cost, producers and distributors would no longer be deterred from spending the money necessary to bring about certain improvements, such as freeing herds from tubercular animals, or installing proper pasteurising plants. The consumer would benefit owing to an improvement in the general standard, and producers, distributors and consumers alike would gain, because a greater consumption would inevitably follow an improvement in quality, and this in turn would lead to an improvement in the physique of the nation. Few adults drink milk now, largely because it does not taste as good as it would were it of better hygienic quality. Imported milk preparations are used more and more wherever possible in the place of raw milk, because the use of the latter is uneconomical owing to its poor keeping quality, which again results in large measure from its low hygienic quality.

IV

Legislation.—The only permanent legislation concerning classification is that provided in the Milk and Dairies (Consolidation) Act of 1915, which includes a provision which first appeared in a slightly different form in the Milk and Dairies Act, 1914, Clause 1, giving the Ministry of Health power to issue a general or special Order "for authorising the use, in connection with the sale of milk, of the designation 'certified milk,' for prescribing the condition subject to which milk may be sold under such designation, and for prohibiting the use of such designation in connection with the sale of milk in respect of which the prescribed conditions are not complied with"; the Scottish Act of 1914 contained no provision relating to classification.

The Acts of 1915 have not yet been put into operation, but classification has been carried on since 1918 under Orders issued by the Food Controller. From the date of the control of milk prices by the Food Controller until the autumn of 1917 the maximum price that producers might charge was a certain number of pence per gallon in addition to what each producer charged immediately before the outbreak of war, but owing to lack of information as to what price producers had really obtained, Lord Rhondda found it necessary to issue an Order (7th Sept. 1917) fixing the actual maximum price that might be charged, and special licences were issued in a few cases for higher prices to be charged where the Food Controller was satisfied that such a course was desirable.

The Committee on the Production and Distribution of Milk, under the Chairmanship of Lord Astor, in its second Interim Report stated in support of the policy which, as Director of Milk Supplies, I had urged upon Lord Rhondda—"In view of the importance of maintaining the health and welfare of child life, the Committee consequently have urged upon the Food Controller the desirability of recognising the production and sale of milk of a higher hygienic quality than the ordinary market milk, and the need for taking the necessary steps connected therewith." The next Milk Order issued by the Food Controller (Mr Clynes) permitted the use of the designations "Grade A" and "Grade B" in connection with the sale of milk under licence granted upon the advice of the Local Government Board, and allowed special prices to be charged for such milk. Subsequently that Order was revoked, and another issued making it illegal to use the designations "Grade A Certified" or "Grade A" in connection with the sale of milk except under licence by the Food Controller.

On 22nd March 1921, in exercise of the powers conferred upon him by the Ministry of Food (Continuance) Act, 1920, the Food Controller issued the Milk (England and Wales) Order, 1921, and the Milk (Scotland) Order, 1921, by the terms of which, the use of the designations "Grade A Certified," and "Grade A," continue to be illegal except under licences to be granted by the Minister of Health, and the Scottish Board of Health, respectively.

In July 1919 the Government announced in the House of Commons that they would bring in a Bill which, *inter alia*, would make provision for the grading of milk, and that an Interdepart-

mental Committee would be appointed to consider the matter, and to advise the Ministers concerned. As a result of this Committee's Report the Milk Amendment Bill was introduced in May 1920 by the Minister of Health (Dr Addison), and seconded by Sir Arthur Griffith Boscawen (the present Minister of Agriculture), who at that time was the Parliamentary Secretary to the Board of Agriculture. The Bill did not receive a second reading, and is therefore dead. Accordingly the situation as it now stands is that unless further legislation is introduced before the expiration of the Ministry of Food (Continuance) Act, in August 1922, no classification can be effected in Scotland and, except in the case of Certified Milk, none in England.

Legislation affecting England, Scotland and Wales should be passed enabling the Minister of Health in conjunction with the Scottish Board of Health to draw up before August 1922 a model scheme for grading milk based chiefly upon its condition as it is offered for sale, which can be applied to milk sold within its own area by any Public Authority that may receive the permission of the Minister of Health or of the Scottish Board of Health. Such powers were contained in the now defunct Milk Amendment Bill. The mere classification of milk cannot affect adversely any legitimate interest; no one would be required to produce any particular grade—it would only enable the purchaser to know the class of milk that he actually received and the producer and distributor to obtain a selling price based on the relative value of the milk offered for sale.

THE MINIMUM WAGE FOR FARM- WORKERS IN SCOTLAND.¹

SIR JAMES WILSON, K.C.S.I.

THE most important class of farm-workers in Scotland is that of the married ploughman, and it will make matters clearer if attention is mainly confined to the effect that the minimum wage legislation is likely to have upon him. Before the war the earnings of the Scottish ploughman were in the main determined by the economic law of supply and demand. If trade was brisk and there was a general demand for labour, the wages of the farm-worker tended to rise with the rise of wages in other industries. If trade was slack, and unemployment was above the normal, his wages tended to fall. If farming was prosperous, there was a greater demand for agricultural labour, and farmers were willing and able to pay higher wages, so that the farm-worker's wages tended to rise. If, on the other hand, farming was depressed, the farmers tried to reduce the number and cost of their staff, and as the demand for agricultural labour thus decreased, there was a tendency for the farm-worker's wages to fall. Owing to the competition of agricultural produce from abroad, and to improvements made in agricultural machinery, there had been for a considerable time a general tendency to a diminution in the number of men and

¹ This article was received on 18th May 1921.

women employed on farms, and therefore to a decrease in the farm-worker's wages, counteracted by an increase in the efficiency of the individual worker, due to an improvement in his education and training, as well as to the extended use of machinery. The level of wages was affected by a rise or fall in the cost of living, but moved up or down more slowly than did the level of prices. Owing to the general healthiness of the rural population and to their birth-rate being normally higher than their death-rate, there was a natural increase in their number, and this had a tendency to increase the supply of farm labour, and therefore to diminish the rate of wages. It was counteracted to a large extent by the migration of the surplus rural population to the towns, to the industrial areas, or abroad. Many of the best young men and women migrated from the rural areas in search of better-paid employment, and, as a natural consequence of the competition among employers for their labour, and of the love of home so strongly felt by many country folk, especially in the Highlands, the level of farm-workers' wages was higher in the industrial parts of Scotland than in the more agricultural areas, and lowest of all in the distant Highlands and Islands.

There are great differences in the value to an employer and to the nation of different individual farm-workers. One man is stronger, more intelligent, better educated, more careful, more willing to work, more trustworthy, more experienced than another, and therefore more efficient and more valuable as a worker, and, broadly speaking, under the untrammelled operation of the law of supply and demand, obtains better-paid employment. As a rule a youth increases in strength, intelligence, common sense, and general trustworthiness, as well as in experience, up to, say, the age of twenty-one, and in the ordinary case for a good many years after that. As he becomes more experienced and more efficient, he naturally commands a higher rate of wage, until, owing to advancing age, his strength begins to fail. Before the war, therefore, it was usual to find that a youth employed in farm-work began with a low wage, which gradually increased as he grew more efficient and more valuable on the farm, until he rose to be a foreman, and in some cases was able to take a small holding or a farm for himself. On the other hand, if, owing to weakness of body or intellect, or of moral character, he proved himself to be comparatively inefficient or untrustworthy, he in course of time could not obtain employment, except at a lower rate of wage than his more efficient fellows.

All these natural tendencies are still in operation as regards the actual earnings obtained by individual farm-workers, and they must always continue in operation, except in so far as they are affected by what may be called artificial restrictions, imposed, for instance, by legislation or by Trade Union action.

Shortly before the war the Farm Servants' Union was initiated and, although it included only a fraction of the total number of farm-workers, it had already secured some success by means of collective bargaining. Its main objects were to obtain for the farm-worker shorter working hours, more holidays, higher wages, and better housing. Since the war its numbers have greatly in-

creased, though it still includes only about one-fourth of the whole number of farm-workers; and, aided by the increase in the demand for farm labour and decrease in the supply caused by the war and by the greater prosperity and goodwill of the farmers generally, it has gradually increased its influence, and, chiefly by means of local conferences with the corresponding branches of the National Farmers Union, it has achieved much success in all those objects, except that of better housing.

The Corn Production Act, 1917, introduced the principle of a minimum wage for farm-workers in Scotland. The main provision of the Act in this respect is Section 5 (6), which runs as follows:—

“In fixing minimum rates under this Section, the Agricultural Wages Board shall, so far as practicable, secure for able-bodied men wages which, in the opinion of the Board, are adequate to promote efficiency and to enable a man in an ordinary case to maintain himself and his family in accordance with such standard of comfort as may be reasonable in relation to the nature of his occupation.”

In interpreting this Section, it may be roughly reckoned that, in an ordinary case, a man will have to maintain himself, his wife and three children. It is obviously impossible to fix minimum rates which shall vary according to the number of children a man happens to have. The chief difficulty is that of deciding what standard of comfort is reasonable in relation to the nature of the man's occupation. It is to be remembered that this question is left to be determined by the opinion of the Agricultural Wages Committee, and that the words “so far as practicable” give them some latitude in fixing minimum rates, and leave them free to fix them on general grounds and not in accordance with any strict arithmetical calculation.

The Act requires minimum rates to be fixed for men and boys, and the question arises, at what age is a boy to be considered to have become a man for the purpose. The workers' representatives have strongly urged that many farm-workers' sons are able-bodied within the meaning of Section 5 (9) at the age of 18, and that therefore the minimum rate fixed for an adult workman should be made applicable to all workmen over 18. My own opinion is that as a general rule a youth is not capable of performing the work of a normally efficient workman until he is about the age of 21. Moreover, in an ordinary case a youth of less than 21 has not a wife and family to maintain. If it were laid down that no youth of 18 should be able to obtain employment unless he could find an employer willing to pay him the minimum rate fixed for an adult man with a family, this would exclude from employment at that age a large number of youths who are well fitted for farm work and anxious to obtain it; so that to apply the adult rate to them is not practicable within the meaning of Section 5 (6). It is also obvious that if the adult rate is confined to men over 21, it can fairly and safely be pitched considerably higher than if it were made to apply to lads of 18. I have therefore used my influence, when it fell to me to exercise it, in the direction of having

a lower minimum rate fixed for youths under 21 than for men over 21, and have been strengthened in this opinion by the facts that as a general rule the wages actually obtainable by youths under 21 are less than those obtainable by men over 21, and that the English Agricultural Wages Board have, as a rule, adopted 21 as the age from which the adult rate shall apply. There is another argument in favour of this course. If one rate were fixed for all ploughmen over 18, it would follow that as soon as a lad came to be over 18 years of age, and to be paid at the minimum rate, he could not, so far as his wages depended upon the minimum rate, expect any increase of wages all through his life as a ploughman, however much his strength, experience and efficiency might increase, and however large his family might become.

As the Act requires the minimum wage to be adequate to enable a man to maintain himself and his family at a reasonable standard of comfort, it might at first sight seem natural to fix a higher minimum rate for a married than for a single man, more especially as in Scotland it is usual, in making bargains, to distinguish between the married and the single men, and to give the married men somewhat higher total earnings than the single men. But to make such a distinction would have a strong tendency towards inducing farmers to employ single men in preference to married men, as they could get them at a cheaper rate, and would thus defeat its own object by throwing married men out of employment. It is therefore not practicable within the meaning of Section 5 (6). This distinction between married and single men has been adopted only in one district, the North West Highlands, where it has probably done little harm, because the rates fixed were below the actual rates obtainable; but the District Committee recently proposed to fix much higher rates, while maintaining that distinction, and probably, if those rates had been passed by the Central Committee, the effect would soon have been to deprive a number of married men of employment on farms in that area. The Central Committee disallowed the rates as too high and unsuitable for the district, and I think they should refuse to pass any scheme of rates which fixes a higher minimum for the married than for the single men.

The Act provides that the minimum rate may be varied in accordance with the standard of comfort which may be reasonable in relation to the nature of the man's occupation. In Scotland, as a general rule, the male farm-workers, other than the stewards, grieves and foremen, may be classified as (1) ploughmen, (2) cattle-men, (3) shepherds, (4) orramen—the last class including all male farm-workers who are not in charge of animals. An orraman so described may be a man in charge of expensive machinery, or engaged in skilled work, such as hedging or ditching, or repairing fences; he may be an old man who is getting past work and unable to earn a full wage, or he may be a young lad under training. It is not practicable to fix separate minimum rates for all these classes of occupation, and it seems best to fix one minimum rate applicable to all men who are not in charge of animals, fixing it low enough to meet the cases of the man who is growing old and of the lad who is under training, and leaving the more skilled orraman to

bargain for a higher than the minimum rate, owing to his greater value and efficiency. The ploughmen, cattlemen and shepherds are all as a rule in charge of valuable animals, and may be reckoned as skilled workmen, except when they are under training. They have also, as a rule, longer and more irregular hours than the orramen, which is a strong reason for fixing the minimum rates for them higher than for the orramen. The actual wage obtained under the law of supply and demand by ploughmen and cattlemen is generally about the same, and although in some parts of Scotland the shepherds receive lower earnings than the ploughmen, this may be due to their isolated position, which has prevented them from obtaining the full advantages of collective bargaining. I think, therefore, that the minimum rate of wages should, as a rule, be the same for ploughmen, cattlemen and shepherds, and should be considerably higher than that fixed for the orramen. The shepherd and sometimes the cattleman has to keep one or more dogs in order to carry out his duties properly, and, as the keep of these dogs costs him something, provision should be made for this by giving him a higher minimum wage on that account. The Border Counties Committee have provided for this by fixing the minimum wage for a shepherd in charge of a hirsle at 53s., as compared with 47s for the able-bodied skilled ploughman. A similar distinction has been made in Sutherland; but most other committees have adopted what I think is the better plan of providing that the minimum rate fixed for a man shall be increased by so much a week for each dog which the workman is required by the conditions of his employment to keep and feed. This covers the case of the cattleman as well as of the shepherd. It is important to note that this is an increase in the minimum rate, which requires the approval of the Central Committee, and is not a benefit or advantage which may be reckoned as payment of wages in lieu of payment in cash within the meaning of Section 12 (1) (b). The increase in the minimum rate for the dog at present in force varies from 2s. to 3s., and is in most districts 2s. 6d. a week.

A thoroughly efficient farm-worker is a highly skilled man, and, to attain skill, experience is necessary. While a man is under training and gaining his experience, his occupation is generally different in character, and requires more supervision than when he has become thoroughly efficient; and during the period he is under training his value as a worker is less than it is when he can be considered thoroughly trained. This is generally recognised in agriculture as in other industries by giving a higher wage to the experienced man than to the inexperienced, and a similar distinction should be made in the minimum wage. It is only reasonable that an experienced man should be able to maintain himself and his family at a higher standard of comfort than he could when he was under training. A number of wages committees have recognised this distinction by fixing a lower rate for the inexperienced than for the experienced worker. For instance, in the Clyde and Forth area the minimum wage for an experienced ploughman over 21 is 10s. higher than for one who has had less than two years' experience of farm work. In the Lothians and Peebles district the corresponding difference is 8s. a week. In the

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Border Counties an experienced ploughman over 18 has a minimum wage 4s. 6d. higher than an inexperienced ploughman; and in Forfar and Perth a ploughman over 21 with two years' experience in agriculture has a minimum wage 3s. 4d. higher than a man with less than two years' experience. Probably some such distinction as this should be made in all districts.

In deciding what wages are adequate to promote efficiency, and to enable a man to maintain himself and his family in accordance with a reasonable standard of comfort, the most important matter for consideration is the cost of living, as indicated by the level of prices. *The Labour Gazette* gives every month an estimate of the rise in the cost of living of an ordinary working-class family in the United Kingdom, as compared with what it was in July 1914. According to this estimate, the average percentage increase since July 1914, including all items (food, rent, clothing, fuel, light, etc.), has been as follows:—

Month (beginning of).	Percentage Increase.
December 1918	120
June 1919	105
December 1919	125
June 1920	150
November 1920	176
December 1920	169
January 1921	165
February 1921	151
March 1921	141
April 1921	133
May 1921... ..	128

According to this estimate, taking the cost of living in July 1914 as 100, it was in December 1918 (immediately after the Armistice), 220; it fell to 205 in June 1919; then rose fairly steadily until in November 1920 it was 276 (its highest point), and since then it has fallen steadily until on 1st May 1921 it was 228. This means that in order to buy the same quantities and qualities of necessary articles the working man would have to pay in May 1921 about 23s. for what cost him 10s. in July 1914, so that to enable him to house, feed and clothe his family as he did before the war his wages would have to be 2·3 times what they then were. *The Labour Gazette* explains that the result of this calculation is to show the increase in the cost of maintaining unchanged the average pre-war standard of living of the working classes—that is, the average standard actually prevailing in working-class families before the war—irrespective of whether such standard was adequate or not. It is obvious that this calculation requires some adjustment before it can be applied to the case of the Scottish farm-worker. In the first place, some articles in common use have risen in price much more than others, and it is only reasonable to assume that the housewife would alter her purchases accordingly by substituting the comparatively cheap articles for

the comparatively dear. Again, this calculation is based on retail prices, whereas in a great part of Scotland the married ploughman receives allowances which are, in accordance with Section 12 (1) (b) of the Act, reckoned towards his wage at wholesale prices, which are considerably cheaper; and, more especially, his cottage which he holds free of rent and rates, is so reckoned at the amount entered in the last Valuation Roll, which is often much below its present actual renting value. However, if allowance be made for these considerations, the figures in *The Labour Gazette* afford the best arithmetical basis for an estimate of the rise in the cost of living since pre-war days.

As stated in my Report on Farm-Workers in Scotland, the average weekly earnings of the married ploughman in Scotland in 1914 were about 22s. a week, while in summer 1920 they were about 55s. a week, a rise of 150 per cent., which closely corresponds to *The Labour Gazette's* estimate of the rise in the cost of living between July 1914 and June 1920. After that date, however, the increase in the cost of living rose rapidly till November, and has since fallen to 128 per cent. in May 1921, and, as no great change in the level of actual wages seems to have taken place last Martinmas, it would seem that the present level of actual average earnings—that is, up to Whitsunday 1921—is much the same as it was last summer, and gives a somewhat larger increase than the increase in the cost of living for 1st May, in the proportion of about 150 per cent. rise in earnings compared with 128 per cent. rise in cost of living.

No doubt when a wages committee fixed a minimum rate of wages, it took into consideration *The Labour Gazette's* estimate of the rise in the cost of living for the previous month, although it did not necessarily follow it closely in fixing the minimum rate. For instance, when on 17th August 1920 the Central Committee fixed the minimum rate for an experienced ploughman, cattleman, or shepherd in the Clyde and Forth district at 50s. a week, it took into account the fact that *The Labour Gazette's* estimate of the rise in the cost of living on 1st August was 155 per cent. above its cost in July 1914, though that was not the only consideration which determined its decision. If the question arose of revising the minimum rates for the Clyde and Forth district, the fact that *The Labour Gazette's* estimate of the increase in the cost of living has fallen from 155 in August last to 128 in May 1921, and seems likely to fall still further, should no doubt be taken into consideration, but it does not necessarily follow that there should be a corresponding reduction of the minimum rate, as, in fixing that rate, other matters have to be taken into account, among them the consideration that, just as wages usually rise more slowly than prices, a reduction in wages should in fairness be made more slowly than a reduction in prices.

There remains the question as to whether the standard of comfort attained by the Scottish farm-worker before the war was a reasonable one. When the average earnings of the married ploughman were only about 22s. a week his standard of comfort was no doubt low as compared with that of workmen in many industries, even if allowance be made for his comparatively

healthy open-air life. More especially, the standard of his housing accommodation was undoubtedly unsatisfactory; and, if there had been no war, probably it would have been reasonable to fix the minimum wage at such a level as to increase the average earnings of the married ploughman in those days, so as to enable him to pay for a better standard of comfort for his family, especially in the matter of house accommodation. But, on the other hand, it may be asked whether—after an exhausting war, which has destroyed such an immense amount of capital, has saddled the country with an enormous debt, and has led to a great increase in taxation, when so many of his fellow-countrymen and countrywomen have had to reduce greatly their previous standard of comfort, and when wages are falling, and there is so much unemployment in other industries—it is reasonable that the ploughman should expect to secure a better standard of comfort than he enjoyed in the more prosperous times before the war. On the whole, I think that in present circumstances a fair standard for the minimum wage is one which will enable the average married ploughman to keep his family at a standard of comfort at least equal to his pre-war standard, and that he should wait for better times before he expects to secure a higher standard.

It is to be remembered that the rate to be fixed is a minimum below which a farmer is forbidden to employ a man, and below which a man will be unable to obtain employment, though he may be willing to work for a lower wage; while, on the other hand, no man is prevented from demanding a higher wage than the minimum, if his skill and efficiency and the state of the market enable him to do so. It therefore does not follow that the minimum wage should closely correspond with the actual average wage paid at any particular time. If the demand for labour be keen, and the supply insufficient, the actual rate of wages may, for the time, be much higher than is necessary for the man to maintain a reasonable standard of comfort. On the other hand, it does not follow that the minimum rate should be reduced when the actual rate falls owing to a decrease in the demand for labour, or an increase in the supply of labour. Indeed the main intention of the minimum wage legislation may be said to be to prevent a fall of wages which would take place if the competition for employment were free from restriction. It seems probable that in the bargainings now being made for the wages to be paid after Whitsunday, there will be a considerable reduction in the actual average earnings, but it does not follow that there should therefore be a reduction in the existing minimum rate of wages, which it may be necessary to maintain in order to prevent the farm-worker's standard of comfort from being reduced below a reasonable standard.

Another point in this connection is the question of the difference to be made in the minimum rates in different districts. It is sometimes argued that all over Scotland the same standard of comfort should be secured to the ploughman, and therefore one minimum rate of wage should be fixed for the whole country. The inquiry recently made shows that at present the standard of comfort, as measured by the cash value of the total earnings of the

average ploughman, varies greatly in different parts of the country, being higher in the industrial areas and lowest in the Highlands and Islands. To apply an average minimum wage to the whole country would evidently make it too low to have much effect in the industrial areas, and would involve a disastrous change in the conditions in the Highlands and in some of the agricultural districts. For instance, if a minimum rate of 50s. for an experienced married ploughman was fixed for the country as a whole, it would be impossible for many farmers to maintain their present area of cultivation, and a large number of workers would be thrown out of employment in the poorer districts. The Act has provided for this by arranging for the division of Scotland into different districts, and by leaving it to the District Committee to fix minimum rates suitable to the circumstances of the district. The standard of comfort varies from district to district, and the best measure of it is the variation in the actual average earnings: so that in fixing the minimum rates for a particular district regard should be had to the present actual average earnings, though that standard should not be too closely followed.

For a similar reason, I think that in some districts it would be well to have different minimum rates for different parts of the district. For instance, in the Lothians and Peebles district, the actual rate of earnings has always been lower in Haddington than in Midlothian and Linlithgow, and a similar difference might fairly be made in the minimum rates for those counties. Again, in the Clyde and Forth district, it would be well to have separate minimum rates for (1) the more purely industrial area, and (2) Stirlingshire, South-East Lanark and North Dumbarton, which are more rural in character, and where the existing actual earnings are less than in the Lower Clyde Valley. And again, in the South West Highlands district, a distinction might be made between (1) the area on and near the Clyde estuary, and (2) the more distant islands and glens, where the existing rate of wages is lower.

Working Hours.—The Act permits, but does not require, a committee to vary the minimum rate according to the number of working hours or the conditions of the employment—and in England the Agricultural Wages Board have generally fixed the minimum wage as to be reckoned on a certain number of hours, with a provision for overtime rates to be charged on any employment beyond that number of hours. It is not necessary to adopt this plan, as the purpose of the Act can be carried out by fixing a minimum rate per week, to be paid whatever be the number of hours worked. During the war I was against fixing any number of hours as a basis for reckoning the minimum wage because there was a danger that, if this were done, it would tend to reduce the actual amount of work done in the field at that critical time. When the National Farmers Union and the Scottish Farm Servants Union, at their Conference held at Perth on 14th February 1919, came to an agreement on the question of hours (quoted on page 32 of my Report on "Farm-Workers in Scotland") it seemed to me that the two parties had arrived at a very reasonable compromise on this important question, and that the Statu-

tory Wages Committees might quite well adopt the principles of that compromise (although the agreement afterwards fell through owing to a dispute on a minor point) as the basis on which the minimum wage should be reckoned, in order to encourage its adoption throughout the country. It is to be remembered that a Wages Committee cannot enforce the adoption of any particular number of hours on any individual farm. All they can do is to say that, if the hours actually worked are in excess of the hours on which the minimum wage is based, the minimum wage payable in that particular case must be increased accordingly; and, so long as a farmer pays the enhanced minimum wage so calculated, he is free to keep his men employed for as many hours as they have contracted to work. The principles of the Perth agreement have been embodied in the schedules of minimum rates fixed for the Dumfries and Galloway district, and for male workmen over 21 in the Forfar and Perth district.

In some other districts the minimum rates have been made to apply to the hours of employment customary in the district in which the worker is employed. This is not a satisfactory arrangement, as it leaves it open to dispute as to what are the customary hours; and, if a definite number of hours is not fixed, then it seems better not to say anything about hours or overtime at all in the order fixing minimum rates. This course was followed in the orders passed by the Central Committee for the Lothians and Peebles and Clyde and Forth districts. In that case, no question will arise as to the number of hours actually worked, the only question being whether or not the workman received wages not less than the minimum rate fixed, whether his hours worked were long or short.

The farmers' representatives have all through had a strong objection to the fixing of any number of hours for the calculation of the minimum rate. On the whole, it seems best at present not to mention hours in the order; but there is a movement among the farmers to increase the number of hours actually worked and, if this threatens to go too far, it may become advisable for Wages Committees to do what they can to encourage a reasonable number of working hours by ordering that the minimum rates shall be reckoned on a definite number of hours, and that, if work is actually done in excess of those hours, the minimum wages to be paid shall be raised accordingly. I think myself that, taking all the circumstances into account, the agreement which was temporarily reached at the Perth Conference was a very reasonable one, and that in the greater part of Scotland the summer working hours should be 9 hours from stable to stable, to be increased to 10 hours during harvest and other busy times, and reduced to an average of about 8 hours during the winter months, allowance being made for 21 days' holidays or 42 half days' in each year, not to be taken during harvest-time or other busy seasons. This would make the harvest working week one of 60 hours, and the average working week for the whole year about 50 hours. These hours do not include stable work, which should be done in addition by the ploughman and may be reckoned as averaging about 7 hours a week. The ploughman, as a rule, has not only longer

hours than the orraman, but has greater responsibilities than most orramen, as he is in charge of valuable animals. It stands to reason, therefore, that his minimum wage should be higher than that of the orraman, and it is much simpler to make a lump addition to the minimum wage on this account rather than to leave it to be calculated on the number of extra hours he actually spends on stable work, as the latter plan would be certain to lead to disputes difficult to settle. If the stable work were to be estimated as averaging 7 hours a week, and calculated at the low rate for overtime of 1s. an hour, this alone would justify a higher rate for the ploughman of 7s. a week, and, as his responsibilities are also greater than those of the ordinary orraman, I think that the difference in the rate of minimum wage for the two classes should be something like 8s. or 10s. a week in present circumstances. For similar reasons the minimum rate for a cattleman or shepherd should be about the same as that for a ploughman, with an addition for the keep of a dog or dogs, where that is necessary.

Form of Schedule.—While all these considerations should be borne in mind, it is highly desirable that the schedule of rates should be as simple as possible, so as to be easily understood both by employer and workman, and I think that on the whole the form prescribed by the Central Committee for the Lothians and Peebles and Clyde and Forth districts contains almost all that is required. A copy of it will be found in Appendix No. 14 to my Report on “Farm-Workers in Scotland.” That part of it which, in the Clyde and Forth district, applies to male workers other than boys is as follows:—

	<i>Per Week.</i>	<i>Per Hour.</i>
For a ploughman, cattleman or shepherd over 21 years who has had two years' experience of farm work ..	50s.	14d.
For other male workers over 18 years	40s.	10d.

If no ploughman, cattleman or shepherd over 21 with two years' experience can be employed at less than 50s., any man who has longer experience, or is more efficient than the least efficient men employed, will, as a rule, be able to secure a higher wage than 50s., according to his experience and efficiency; and any worker over 18 who is under 21 or has less experience will be able to secure wages approaching 50s. if his experience and efficiency make him worth nearly as much as the experienced man over 21; while the condition that no male worker over 18 can be employed at less than 40s. will prevent him from being thrown out of employment by the competition of men willing to take less than 40s. I should like also to see a lower rate, such as 40s., fixed for all men over 60, whatever their occupation or experience, so as to avoid the danger of a man being turned out of employment when he gets too old to do a full day's work, and is no longer worth the 50s. prescribed for an adult ploughman, cattleman or shepherd.

The Level of the Minimum Wage.—It seems probable that, owing to the fall in prices, the fall in wages in other industries,

and the prevalence of unemployment generally, the actual wages obtainable by farm-workers, whether by individual or collective bargaining, will considerably decrease—and may in some districts tend to fall below the existing minimum rates of wages. Some farmers will naturally argue that the fall in the prices of agricultural produce, obtainable by them, justifies a reduction in the present rates of minimum wages. It may be pointed out, however, that the prices obtainable by farmers are still very much higher than the pre-war prices, as is shown by the Corn Averages for England, according to which the average prices obtained by farmers for the grain sold in the English markets in the week ending 23rd April 1921, compare as follows with those obtained in the corresponding week of 1914—

Grain.	Price in 1914.		Price in 1921.		Level of Prices in 1921 taking 1914 as 100.
	s.	d.	s.	d.	
Wheat per 480 lbs. ...	31	9	87	3	275
Barley per 400 lbs. ...	26	0	46	7	179
Oats per 312 lbs. ...	18	5	36	10	200

From this return it appears that farmers in England are still getting for their grain double the price they got at the corresponding season in 1914, and probably this is true also of the Scottish farmers; and although the prices of wool and potatoes have fallen greatly, the prices of cattle and sheep are still very high. On the whole, therefore, it may be said that from this point of view the farmer can still afford to pay wages at about double the rates prevalent before the war. But the Act requires the minimum rate to be fixed, not so much with regard to what the farmer can afford to pay, as with regard to the cost of living at a reasonable rate of the workman and his family. As I have already shown, *The Labour Gazette's* estimate of the cost of living of an ordinary working-class family in the United Kingdom makes it still 228, as compared with 100 in July 1916; so that from this point of view, on the supposition that the standard of living attained in 1914 was a reasonable one, to maintain the same standard now would require an average rate of wages about 2·3 times what it was in 1914. On page 50 of my Report I have estimated that in 1914 the average earnings of the married ploughman in Scotland were about 22s. a week, and if the present estimate of the cost of living at 2·3 times that of July 1914 be applied to this figure, it would mean that, in order to maintain the pre-war standard of comfort, the average ploughman should get 50s. a week. As already pointed out, *The Labour Gazette's* estimate of the rise in the cost of living does not strictly apply to the case of the ploughman, and the minimum rate of wage should be somewhat below the reasonable average rate of wage. On the whole, these considerations lead to the conclusion that the average minimum wage for Scotland for experienced ploughmen should be at present somewhere in the neighbourhood of 48s. a week, being higher than this in the in-

dustrial areas, and lower in the more rural districts, and especially in the Highlands. The present minimum rates for an experienced ploughman in the Lowlands of Scotland vary from 50s. in the Clyde and Forth district to 45s. in the north eastern counties, with the exception of Ayr, where the rate is only 37s., and the Moray Firth, where it is only 36s. I think this rate should be raised in the two latter districts, but should not be altered at present in the other Lowland districts. The rates of 45s. in Sutherland, and 46s. in Shetland are perhaps now too high. A case might perhaps be made out for a reduction in some districts of the rate for an inexperienced lad of less than 21, especially if a reduction is made in the value placed upon board and lodging in view of the recent fall in prices.

Minimum Wages for Women.—The Act does not lay down any such standard for the minimum wage for women as it does for able-bodied men, but it may be assumed that, so far as practicable, the minimum wage for an adult woman should be adequate to promote efficiency and to enable her to maintain herself at a reasonable standard of comfort. There is, however, a more important consideration to be taken into account. If the minimum wage for women is fixed too high in proportion to that fixed for male workers, the tendency will be to prevent women from obtaining employment in agriculture. On the other hand, if it be fixed too low, as compared with that fixed for men, the tendency will be for farmers to employ women in preference to men. The safest standard, therefore, would appear to be to adjust the minimum rates for the two sexes as nearly as possible in proportion to their comparative value as farm-workers. According to the inquiry made in winter 1919-20, in the south-eastern counties, where women are chiefly employed as out-workers, the average actual earnings of the women workers over 21 were 55 per cent. of those of the married ploughmen. The best general rule would, therefore, seem to be to fix the minimum wage for an inexperienced woman over 18 at about half that fixed for the experienced ploughman, and the rate for an experienced woman worker a little higher. This has been done in the Clyde and Forth district, where the rate for an experienced ploughman is 50s., for an inexperienced woman is 25s., and for a woman with twelve months' experience, 28s.

Work in Market Gardens, Woods, and Nurseries.—I think that the minimum rates for work in market gardens should be the same as for farm work, but that in some districts lower minimum rates should be fixed for work in woods and nurseries, so as to make it easy for feeble men and for women and children to obtain temporary employment of this character, especially in winter, and in slack seasons. Such a provision would be particularly useful where forestry operations are being carried on in the neighbourhood of crofting communities.

The Probable Effect of the Minimum Wage.—It may be useful to speculate on the probable effect of the minimum wage in agriculture in Scotland, and perhaps the best way of discussing the

question is to take a somewhat extreme case. If in a district the minimum wage for all male workers over 18 was fixed and maintained at 55s. a week, while the general level of wages in other industries fell to 40s. a week, farmers in that district would endeavour to employ as few men as possible and only the most efficient farm-workers would obtain employment. The first to drop out would be those men who, owing to advancing age, or to infirmity of body, mind or will, were less efficient than their neighbours; and no youth over 18 would obtain employment on a farm unless he was above the average in efficiency. The less efficient men of the farm-worker class, both old and young, would be forced to seek for employment in other industries, and the men who obtained employment as farm-workers would become a privileged and exclusive class. Their higher wage, as compared with their fellows outside, might lead to their becoming more efficient and turning out more and better work than before; on the other hand, it might have the effect on some of them of making them take advantage of their privileged position to do less work than they would do under the stress of open competition. The tendency to reduce the number of men employed would probably have the effect of sending more land down to grass, and of decreasing the production of grain crops, counteracted to some extent by the farmers' efforts to make more use of machinery, and to improve their yield per acre by more scientific methods of cultivation. There would also be a tendency towards a reduction in the rural population of that district. If in a neighbouring district the minimum rate were in these circumstances reduced to 40s. a week, the more efficient workers would tend to migrate from that district to the 55s. district, where they would command higher wages, displacing the less efficient men from the 55s. district, who would tend to migrate to the 40s. district; and the result would be that the farmers in the 55s. district would have fewer, but more expensive, and more efficient, workers than in the 40s. district, where the farmers would obtain men at lower wages, and would be able to employ more men, but of a less efficient stamp. The farmers in the 55s. district would probably feel that they were handicapped in their competition with the farmers in the 40s. district.

Tenant-farmers as a class expect a certain rate of profit on their capital, and of payment for their labour as managers of the business of the farm, and can in the long run protect themselves against an increase in the cost of production by offering lower rents. And, after some time, if they found that their profits were reduced owing to the higher cost of labour, they would, as a body, tend to offer lower rents and thus throw the whole or greater part of the loss so caused on to the landowner. Thus, if the minimum rate were fixed too high, the ultimate result would probably be that there would be a smaller, but more prosperous and probably more efficient, farm-worker class, and that the rents obtainable by landowners would be less than before, while the farmers' net income would return to much what it was before the rise of wages. This result would discourage the investment of capital in the improvement of land, and would reduce the income of the land-

owner, the capital value of his rights in the land, and his credit as a borrower.

If the minimum wage policy were extended to all industries, and the minimum wage fixed higher than the industries could afford to pay, the more inefficient members of the working population would be unable to obtain employment at all, and would either have to emigrate or to be maintained at the expense of the general community. In fixing minimum rates of wages, therefore, while endeavour should be made to keep them high enough to secure to the worker a reasonable standard of comfort, care should also be taken not to make them unduly high with regard to the circumstances of the time.

POULTRY ON THE FARM.

MISS SHIRRA GIBB.

THE average farmer's wife or daughter does not realise how profitable poultry kept on the farm can be if time is available and they are really properly managed. It is impossible for the farmer's wife, who has a family and house to attend to, to do any poultry keeping except on a very small scale—*e.g.*, the annual spring cleaning and the chicken rearing both come at the same season. In the same way the poultry work will generally be found to interfere with other household duties. It is much better if one member of the family can take up this branch and begin it like a separate business, investing a certain amount of capital in buying good stock and good housing and appliances.

A short training is desirable or a few weeks spent working on a well-managed poultry-yard, to learn by practical experience how things should be done to ensure success. Very little of the literature on the subject is applicable to poultry kept on the ordinary mixed farm, "the well-balanced ration" of the poultry-book being completely upset whenever an oat, wheat or barley stack is lifted from the stackyard for thrashing, and the fowls have before them a large supply of grain food equal to four or five days of the ordinary grain ration.

Balance Sheet.—The accompanying balance sheet for 1920 will give some idea of the receipts and expenditure for a farm poultry-yard of about 150 birds.

The breeds kept are White Wyandotte fowls and fawn-and-white Indian Runner ducks.

No allowance is made in the balance sheet for rent of land, as no special part is portioned off for the poultry, and the poultry manure is supposed to counterbalance the rent of the land run on by the hens, which is all grass, there being no cropped fields near the fowl houses.

The following notes explain the balance sheet as it appears.

The 80 pullets (1919-1920), which have given an average egg-yield of 165.66 eggs each during their pullet year, are housed in the large laying house (Fig. 1) in the stackyard, so as to be away from the breeding stock.

The breeding stock and ducks are housed in movable colony houses in a grass field about 200 yards from the stackyard. The

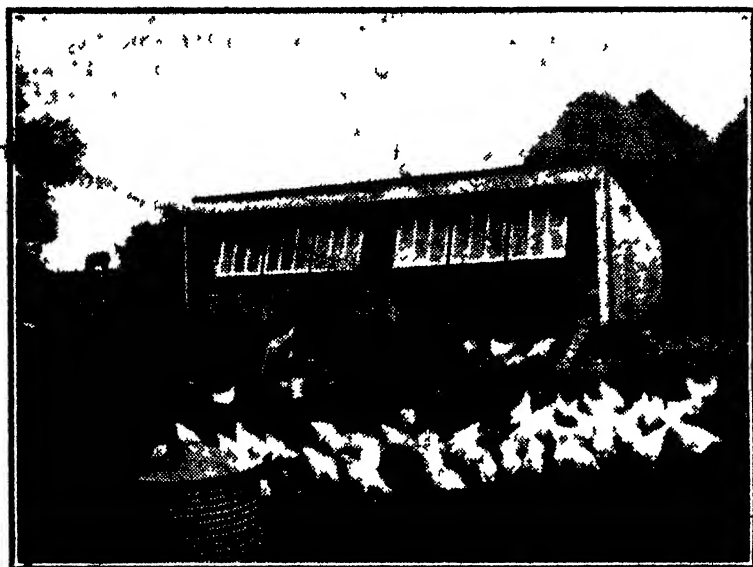


FIG. 1 —LAYING HOUSE



FIG. 2 —BREEDING HOUSE.

second figure shows a house of this type in process of being moved.

Under the title "Appliances" are included all the fowl houses, rearers, incubator, and other implements, and the date of purchase

BALANCE SHEET, 1920.

[illegible]

of each article is given. The value of all appliances is entered in full the year they are bought, then $12\frac{1}{2}$ per cent. depreciation is deducted each following year.

The Tamlin Incubator, which was bought second-hand in 1908, is classed along with the coops, troughs, pails, etc., owing to its price having undergone twelve years' depreciation at the usual rate of $12\frac{1}{2}$ per cent. per annum, although it is as good as ever it was, as far as practical hatching is concerned.

The expenditure on foodstuffs may seem low to the poultry keeper who has every thing to buy, but if household scraps, boiled brock potatoes, turnips, home-grown grain and oatmeal to the value of about £40 are used, together with ingredients that have to be bought, such as bran, thirds, fish-meal, Indian corn and maize-meal, amounting to another £40, it will be found that the cost of foodstuffs, etc., works out at about £80.

The station account is for railway carriage charged for hampers and egg-boxes sent to customers.

The sundries include stamps, the cashing of cheques, etc.

The new stock and eggs bought in are for the supply of breeding cockerels and drakes.

The valuation of the eggs used for hatching was calculated at the market price when set (4s. per dozen in February to 3s. 6d. in March), and the price of the breeding cocks used was added, making a total of £9, 10s. (For the new hopper and egg-boxes see below.)

The wages would be added to the profits if the farmer's wife or daughter attended to the poultry herself; but I have put in the whole estimated sum into the balance sheet in case there should be no member of the family available to attend to the poultry, when a hired experienced poultry keeper would be required. An average of 7 hours per day at 1s. per hour equals £127, 15s.

About 4 hours per day would be enough for the autumn and winter, but from 8 to 9 hours per day would be needed for hatching and rearing time in the early spring and summer. This would include the time spent on book-keeping, egg packing, etc. Again under the circumstances where the farmer's wife or daughter does the work in an ordinary way, but requires assistance in the hatching season, the assistant's wage could be calculated at 1s. per hour.

The eggs sold for £267, 15s. 10½d. include ordinary marketing eggs and those sold for setting. The poultry sold includes dead trussed poultry sent to private customers, live poultry sent to dealers, and live stock birds sold to neighbouring farmers for breeding. The eggs and poultry supplied to the household are charged at current market prices, and generally have been found to balance pretty closely the foodstuffs used.

The 80 pullets are the chickens hatched in 1920 from hens specially selected from the breeding stock.

Of the breeding hens 38 were selected from the 80 pullets of January 1920, and along with 7 specially good old hens which were kept, make up the total of 45, from which a fresh selection was made in the beginning of February 1921, when the present breeding pens were made up.

The ducks have proved splendid layers, giving an average of 188·5

eggs, but they should be kept separate if possible from the other stock, as they steal the food and foul the ground.

General Management.—Good, dry, well-lighted houses are very important, and save a lot of labour. For instance the early morning feed can be scattered in the litter the night before, and so save the poultry-keeper getting up at six in the morning, as the hens hop down from the perches and find the grain whenever it is light enough in the morning for them to see it.

The laying house given in the first photograph measures 24 feet long by 10 feet wide, and is 7 feet 6 inches high in front and 4 feet 6 inches at the back. The wooden floor is raised about a foot from the ground, and wire netting is run round to prevent rats, etc., from getting underneath it. There are six windows, which throw plenty of light on to the floor so that the hens can see to pick up the grain which is scattered in the litter. This house was considered rather costly at the time it was put up, but the extra egg-yield and the saving of labour soon justified the purchase.

The four smaller houses, which hold the breeding stock and ducks, are fitted with strong sledge runners, which are in practice found to be much more serviceable than wheels. They are not difficult to move, one horse being quite sufficient.

Good stock birds are as necessary to profitable poultry keeping as good housing, so well-bred male birds are bought, or reared from eggs got from a utility poultry-yard where trap-nesting and pedigree breeding are carried on, rather than from an exhibition breeder who goes in for combined fancy and utility stock.

A good price is paid and a healthy, medium-sized bird purchased which has been bred from a trap-nested pedigree hen with an egg record of 230 to 260 two-ounce eggs in her pullet year. This cockerel or cock is mated to 12 or 15 second-season hens which have been specially selected from the rest of the flock, and housed in a colony house situated at a little distance from the others to prevent the birds from mixing.

I think line-breeding or in-breeding is a mistake on a farm where the birds have free range. For one thing they cannot be so carefully watched and culled as when kept in wire runs. The general health of the stock, a good average egg-yield for the whole flock, and the rearability of the chickens, are of greater importance, in my opinion, than the production of a few "record egg layers" which, because of their freedom, cannot be trap-nested.

Feeding.—The adult stock is fed three times daily. The first feed, as stated before, consists of oats, which are scattered in the litter in the houses the evening before—about half-an-ounce being allowed to each bird. This overnight feeding can be done successfully only if the houses are well lighted and have good rat-proof floors. For the second feed a wet mash is given at about 8.30, also in the house, before the fowls are let out. The ingredients of the mash are portioned out by measurement, a corn scoop holding about one pint being used.

The quantities of the different meals are varied to suit the season of the year, but the following mash has been very generally used throughout:—

- 4 scoopfuls of house scraps and cooked vegetables (potatoes, turnips and leaves of cabbages), together with the liquid they are boiled in.
- 2 scoopfuls of bruised oats.
- 2 " " " bran.
- 2 " " " thirds.
- $\frac{1}{2}$ " " " maize-meal.
- $\frac{1}{2}$ " " " fish-meal.

These ingredients are mixed well and moistened with a sufficient quantity of buttermilk or skim milk and water to make the whole into a soft crumbly condition. About one tablespoonful of this wet mash is allowed to each bird. After the wet mash is eaten the hens are allowed out to forage till the afternoon feed, which is given at 3 o'clock in winter and at 5 o'clock in summer. They are then given as much grain as they will eat readily, without leaving any lying about—say about one ounce each—scattered outside amongst leaves or straw, to give them scratching exercise. This prevents the lazy hen from eating too much, and yet allows the active laying hens to get all the food they want, if they take the trouble to scratch for it. So many farm fowls get their corn thrown down on to a bare piece of ground where they can easily overeat themselves. There is really almost no danger of wasting grain by throwing it amongst rough litter, they pick up every particle of it in time, and the scratching exercise does them a lot of good. A plentiful supply of fresh water and cockle-shell grit is always placed near the fowl-houses.

The chickens are fed principally on oatmeal and bruised oats. The oatmeal is ground at a neighbouring meal mill from ordinary farm oats, and before being fed to the chickens it is sifted through a wire sieve, and the coarse pinhead meal is fed as a dry feed, while the flour is used for a wet mash together with thirds, bran, boiled vegetables and skim milk.

I find the chickens do well on bruised oats as a dry feed, and seem to enjoy picking the kernel out from the husk. As there is a bruiser on the farm, and the oats are being bruised freshly every week for the cattle, it makes a much less expensive diet than buying a dry chick feed which has to come by rail.

The chickens are fed five times daily, getting two wet-mash feeds, and three dry feeds. Whenever possible skim milk or buttermilk is used for the chickens, either as a drink or to moisten the mash. When milk is scarce a little fish-meal is added to the water used to moisten the mash.

IN Vol. V. (1920) of the *Annual Reports on the Progress of Applied Chemistry*, recently published by the Society of Chemical Industry, Dr E. J. Russell, the Director of the Rothamsted Experimental Station, describes the progress of agricultural chemistry during 1920.

FERTILISERS.

Dealing first with fertilisers, Dr Russell points out that the most important fertiliser problems before the agricultural chemist

are those associated with nitrogenous fertilisers and basic slag.

Nitrogenous Fertilisers.—One of the most striking developments of the war was the enormous expansion of plant for the fixation of gaseous nitrogen, and it was generally supposed that the end of the war would see a gigantic output of nitrogenous fertilisers, more than necessary for the immediate requirements of agriculture. Nothing of the sort has happened, however, and sulphate of ammonia and nitrate of soda still retain their old position as the most important nitrogenous fertilisers. Before the war no great amount of nitrogen fixation was actually being carried out, but to-day all the large civilised countries of Europe have extensive plant. An excellent summary of the position is contained in the *Report of the Nitrogen Products Committee* (Cd. 482) (1920). The total possible output of combined nitrogen from existing plants in Germany alone is put at 500,000 tons; this amount is equivalent to $2\frac{1}{2}$ million tons of sulphate of ammonia, which is nearly double the pre-war consumption of the whole world.

The British plant is also extensive, as also is that of France, Norway, Sweden and Italy, so that there is no need to fear the nitrogen starvation which was predicted in the nineties. On the other hand, there is nothing approaching a glut at present, as the use of nitrogenous fertilisers is increasing greatly.

Turning to particular fertilisers, nitrate of lime has on an average proved as effective a fertiliser as nitrate of soda, though in special conditions the advantage lies sometimes with the one and sometimes with the other.

Ammonium salts will apparently be produced synthetically in larger quantities than any others. The carbonate would have many advantages, but is volatile and easily decomposable.

The cheapest salt to prepare would probably be the chloride, and field experiments are being carried out to find out how it compares with other salts.

In some ways the manufacture of calcium cyanamide or nitrolim is easier than other processes for nitrogen fixation, and there has been a great expansion of plant during the war. The production in Continental countries during the past year was restricted owing to lack of coal.

In a summary of the field trials with these various nitrogenous fertilisers it appears that their order of effectiveness is nitric nitrogen 100; ammoniacal nitrogen 97; cyanamide nitrogen 90 or less. The effectiveness of any one fertiliser depends of course on the particular local conditions. The decomposition which nitrolim undergoes in the soil is not yet fully understood. Until this has been worked out it is probably safer not to use the fertiliser as a top dressing, but to use it at or before time of sowing.

Phosphates.—Phosphates are of equal importance with nitrogen compounds as fertilisers. The two great sources are basic slag and mineral phosphates. The latter was formerly used almost entirely as superphosphate, but is now attracting attention for direct application to the land. The changes recently brought about in the process of steel-making have entirely altered the

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character of the slag which is put upon the market, and makes it necessary for further experimental work to be carried out to determine the value of the new types of slag. This aspect of the question is dealt with separately in the article on basic slag, p. 321.

*Potash Fertilisers.*¹—Before the war we were dependent entirely upon Germany for our supplies of potash salts. Now there are three possible sources of supply: (1) from Stassfurt in Germany, as before the war; (2) from the mines in Alsace, a recent development; (3) from such national war-time enterprises as survive into the post-war period. With (1) it is unnecessary to deal further, except to state that during 1919 the production was much below the pre-war output. (2) The Alsace deposits. Since the Armistice these deposits have been strenuously developed. They differ in one important respect from the German: they consist mainly of chlorides, while the Stassfurt deposits contain sulphates as well. Full advantage has been taken of the temporary German disorganisation by the Alsace authorities to develop their mines. The estimated production is:

		<i>Crude Salts.</i> Tons.	<i>Pure Potash.</i> Tons.
1920	.	1,320,000	220,000
1921	.	2,040,000	340,000
1922	.	2,340,000	390,000

From the Armistice up to February 1920 Germany had supplied this country with only about half as much potassic salts by weight as came from Alsace (19,280 tons against 37,258 tons), though by reason of their greater richness the value was higher (£323,727, against £275,476). (3) It still remains to be seen whether any of the new potash industries started during the war will survive the competition with the natural sources of potash.

SUPPOSED STIMULANTS TO PLANT GROWTH.

Persistent claims have been put forward in recent years that plant growth could be increased by the use of certain stimulants which would allow full advantage to be taken of nutrient salts or other favourable conditions present. The methods fall into two groups dealing respectively with the seed and the growing plant.

Seed Treatment.—It has long been known that germination could be hastened and seedling growth improved by preliminary treatment of seeds with certain substances, but it has not been clear that the final growth of the plant was affected except in cases where fungus spores were concerned. A treatment known as the "Wolfryn process" has been brought out which comprises soaking and electrolysis in a salt solution with subsequent drying and is claimed to increase final yields. No satisfactory confirmation of this claim could, however, be obtained. An exception must apparently be made of infected seeds, where heating has been shown to be a feasible treatment, as the seeds will withstand temperatures fatal to the fungus.

¹ See also p. 326

SOILS.

The most important work which has been engaging the attention of the agricultural chemists in recent years has been on the sourness or acidity in soil. The problem is being attacked from different sides, and much useful work is being done, but the investigations are still far from complete.

FEEDING.

Some difficulties connected with the analysis of feeding stuffs are discussed, and a review is given of recent work on Vitamins (see below).

Straw as Food.—Methods by which it has been attempted to increase the digestibility of straw are described, but no scheme suitable for practical application has yet been devised.

IN the *Journal of the Society of Chemical Industry* for March, vol. xl., No. 5, p. 79, r, Professor A. Harden contributes an important article on the occurrence of vitamins in various foodstuffs, and explains the effect of a deficiency of the different vitamins on the nutrition and growth of the animal. He also deals with the not less important question of the influence of processes of manufacture or preparation on the vitamin content. While the article deals primarily with human foods, it is nevertheless of much interest to agriculturists, and the conclusions drawn are, in many cases, equally applicable to the feeding stuffs of the farm.

The recent article in the *Journal*¹ will have made readers familiar with the functions which vitamins fulfil in nutrition, so that it is unnecessary to take up time in describing them again. Two important points, however, may be mentioned. First, that the mammalian organism is unable to synthesise these principles for itself and is entirely dependent for its supply on the food with which it is nourished; second, that the young growing organism requires a relatively greater supply of them than the adult. It must further be remembered that the offspring is in its early stages entirely dependent for its nutrition upon the mother, who has therefore to receive a supply of vitamins adequate for the needs both of herself and of her young.

The distribution of these factors among the common articles of diet of man and the domestic animals is being gradually worked out, but there is still much to be done. The following table (p. 319) shows the occurrence and functions so far as they have been investigated.

VITAMIN REQUIREMENTS.—Our knowledge of the vitamin requirements of different animals is still very imperfect. One important conclusion which has been definitely ascertained in this respect is that different animals, even although closely related,

¹ This *Journal*, vol. iv., No 2, p. 140.

vary very considerably in their need for vitamins. The requirements are, of course, much greater in the young growing animal than in the adult, and where a mixed ration of more or less fresh and natural foods is being fed, the danger of the lack of vitamins is comparatively small. It is in cases where the ration is confined

	Vitamin A or Fat-soluble A.	Vitamin B or Water-soluble B (Anti-neuritic).	Vitamin C or Water-soluble C (Anti-scorbutic).
Effect of deficiency ..	Retarded growth, ending in death, eye disease (<i>Keratomalacia</i>), probably one factor in causation of rickets	Retarded growth, ending in death, beri-beri, polyneuritis of birds, rats, etc	Scurvy
Chief sources	Animal fats, fish liver oils, green vegetables, egg-yolk, butter and milk, oleo-margarine, in proportion to animal fat	Seeds, particularly in the germ, pericarp and aleurone layer, yeast, egg-yolk	Green vegetables (especially cruciferae), orange & lemon juice, tomatoes, germinated seeds, swedes & turnips
Present in smaller amounts ...	Oil-seeds, carrots	Meat, milk, potatoes and some other tubers and roots, green vegetables, some fruit juices	Meat, milk, potatoes and some other tubers and roots, many fruit juices, dried vegetables
Absent from...	Most vegetable oils, most lard, most margarine, white bread, egg-white, yeast, purified proteins, & carbohydrates	White bread, polished rice, fats, egg-white, purified proteins and carbohydrates	Seeds, white bread, fats, yeast, purified proteins & carbohydrates

to one or two foods, and in particular during winter feeding, that the danger of a shortage of vitamins is most likely to occur.

VARIATION IN THE VITAMIN CONTENT OF FOODSTUFFS.—It is almost certain that the amount of vitamin contained in natural foodstuffs is not a constant quantity, but varies under different conditions of season, age and so forth. Very little accurate work has yet been done in this direction, but indications have been observed, for example, that the anti-scorbutic potency of grass is greater when the grass is young than when it is fully grown. Another case is that of seeds which may contain a vitamin during the germinating stage while the dried seed itself contains little or none of the principle.

When we come to deal with secondary foodstuffs—for example,

milk—a further complication arises, since the vitamins are all derived from the feeding stuffs, and the amount present in the milk might thus be expected to vary according to the nature of the ration. On the other hand, in cases where very little vitamin is supplied, the amount of milk secreted might be diminished, while the vitamin content was kept up, or a certain amount of the vitamin might be obtained from the tissues of the mother. Here, again, the experimental evidence is not yet conclusive. Hopkins, at Cambridge, found that the fat-soluble factor of goat's milk remained approximately constant when the animal was given a diet deficient in that respect, but that the quantity yielded fell off. On the other hand, in America, several investigators working with cows found only a small diminution in the milk flow, but a large depreciation in the anti-scorbutic potency of the milk, when the cows were given a diet deficient in vitamin C. Indications have also been frequently observed of the anti-scorbutic inferiority of winter to summer milk, and the winter feed given to cattle in this country is frequently very deficient in both vitamins A and C.

It is, moreover, obvious that the vitamin content of many important foodstuffs, such as butter, meat, animal fats, etc., must be dependent on the diet of the animals from which they are derived.

INFLUENCE OF PROCESSES OF MANUFACTURE OR PREPARATION.—*Milling of Grain.*—The classical example of this is the milling of grain (rice, wheat), in which the germ, or embryo, which contains by far the greater part of the vitamin B, and most of the pericarp and aleurone layer, which contain the rest, is removed. In the case of adults, getting a considerable variety of food, the effect of this may not be serious, but it is now well known that where the ration is more limited the effects may be serious. It is also well known that the unbalanced use of milled rice leads to the disease known as "beri-beri," and is the main cause of this disease in the tropics.

Desiccation.—The effect of drying varies very greatly with the nature of the food material. Cabbage loses 70 to 80 per cent. of its anti-scorbutic potency after drying, and similar results are given by many other vegetables. About milk there is still some uncertainty, and it depends upon the precise process employed in drying. If there has been no undue exposure to a high temperature, and if aeration is avoided, dried milks can be prepared not greatly inferior in anti-scorbutic potency to fresh milk.

Heat.—The action of heat on the vitamin content of foodstuffs is, of course, of fundamental importance, since many of the processes of food preparation and preservation involve the application of heat at some stage. The investigation is complicated by the fact that in some cases aeration plays an important part, as well as rise of temperature. The effect of heat depends largely on the nature of the material in which the vitamin occurs.

The practical conclusion as regards the processes of sterilisation is that at present it is unsafe to dogmatise, in particular with regard to the anti-scorbutic vitamin, so that each new case really requires special investigation. It is already known, for example,

that the process of canning largely destroys the anti-scorbutic value of green vegetables, whereas canned tomatoes retain a large part of the high activity of the fresh fruit.

OILS AND FATS.—Particular interest attaches to the presence of vitamin A in oils and fats because these are constituents of all diets and, moreover, form in many cases the chief, if not the only, source of this vitamin. Almost all animal fats have been found to contain this substance, the striking exception being lard.

The vegetable oils form a problem of great importance in this respect. Most of the oil-seeds contain more or less of the vitamin, whereas many of the vegetable oils as placed on the market, and used for the preparation of margarine, are devoid of it. Whether this is due to the small proportion present in the original seed, to the process of extraction or to the subsequent treatment of the oil is not definitely known. Further investigation is urgently called for to settle these important questions. Much has already been done at the initiative of the manufacturers, and thanks to the wise liberality of the Medical Research Council, which has devoted large sums to the support of investigations on the vitamins, steps are now being taken to make a systematic study of this subject, which has so vital a bearing on the health of the population in general, and also is intimately connected with many nutrition problems in the feeding of live stock.

AN important discussion organised by the Faraday Society on the production and utilisation of basic slags is reported in a recent

number of the Transactions of the Society (vol. xvi., pt. 2, p. 261, 1920). At this meeting representatives of steel-makers, agriculturists and agricultural chemists were present, so that the discussions which followed the various papers were particularly valuable.

It should be pointed out that basic slag differs from all the more important fertilisers in common use, inasmuch as it is not manufactured specially for agricultural purposes, but is a by-product obtained in the manufacture of steel, and consequently any change in the method of manufacturing steel may bring about a considerable difference in the quality and composition of the slag which may have a very important bearing on its fertilising value. The slag which was in use before the war—the valuable properties of which are familiar to agriculturists—was mainly produced by what is known as the Basic Bessemer Process. In this country a steady change in the method of making steel has been taking place in recent years, and now practically all the steel in this country is manufactured by what is known as the Basic Open Hearth Process, which gives a slag differing widely in composition and in properties from the old Bessemer slag. As a consequence of this the results of the large amount of experimental work which has been carried out with the old Bessemer slags are not applicable to the slags now on the market, and a fresh series of experiments will be required to bring our knowledge up to date. This point has probably not been sufficiently appreciated by the practical farmer,

and the difficulties which have been experienced in the use of slag in recent years are undoubtedly due to this cause.

Dr E. J. Russell, the Director of the Rothamsted Experimental Station, opened the discussion with an historical review of the early use of basic slag, and referred to the important series of field experiments carried out at Cockle Park under the direction of Professor Somerville, Sir T. H. Middleton and Professor Gilchrist successively. To these three more than to any others we owe the great advances in knowledge of the use of basic slag. Their experiments were carried out with the old Bessemer slag.

Three distinct substances are now used under the one name of basic slag :

- (1) Bessemer slag, containing about 20 per cent. of phosphoric acid (P_2O_5) (43·6 per cent. tricalcic phosphate).
- (2) Open hearth basic slag, 7 to 14 per cent. phosphoric acid (P_2O_5) (15·4 to 31 per cent. tricalcic phosphate).
- (3) Open hearth basic slag, 7 to 10 per cent. phosphoric acid (P_2O_5) (15·4 to 21·8 per cent. tricalcic phosphate), in the manufacture of which a considerable proportion of calcium fluoride has been used.

The object in adding calcium fluoride is to make the slag more fluid.

The phosphorus of the first two types of slag is nearly all soluble (85 per cent. or more) in 2 per cent. citric acid under certain conventional conditions : that of the third type is not—only 20 per cent. or less dissolving.

It may be said at once that no important agricultural distinction between the first and second of these classes has been proved with certainty when the slags are used in quantities containing equal amounts of phosphorus, and so far as present information goes, these slags are of equal value per unit of phosphorus to agriculturists. There are, of course, disadvantages in low-grade materials, in that large bulks have to be handled, and therefore larger expenditure is incurred, and deliveries to the farm or fields may be delayed. But when allowance has been made for these items there is no great difference between the two classes of slag. The third class, however, is somewhat different, and agricultural investigators generally agree that it is less effective than the first two types, though they have not yet wholly succeeded in evaluating it.

The problem thus resolves itself into three broad divisions :

- (1) What is the agricultural value of the various basic slags likely to be available in the near future ?
- (2) Is this value related to the chemical constitution of the slag in any simple way that would allow of some chemical expression and on which an evaluation method might be based ?
- (3) Is it possible for the steel works to raise the phosphorus content of the slag and generally to increase the effectiveness of the so-called low-grade slags ?

An extended trial with the three types of basic slag is now being organised under the auspices of the Agricultural Education Association by workers in different parts of the country, and the result should give much valuable information.

Dr Russell then described the general results obtained in the experiments at Cockle Park, and discussed the possibility of other constituents in the slag apart from the phosphate being of fertilising value. It was formerly supposed that the free lime in slag was of great importance until it was realised that not more than from 2 to 3 per cent. of free lime was present, so that the amount added to the ground is negligible. The Bessemer slag, however, produced effects on heavy grassland which could not be obtained by equivalent dressings of mineral phosphate or super-phosphate. In this country it is assumed that the phosphate in basic slag is in the form of a silico-phosphate, which may differ in physiological action from the ordinary phosphate. In France, on the other hand, the view is held that some of the other constituents present in small quantities are of importance, and the manganese content of slag is actually determined. Direct experiments with manganese compounds in this country have not so far given promising results. The question of the fineness of grinding was also considered, and the experiments of Collins were quoted, which show that the standard sieve of 100 meshes to the inch affords the best results. There is no evidence, however, for supposing that fineness of grinding is the sole factor or is anything more than an important secondary consideration. Summing up, Dr Russell said he saw no reason to depart from the customary British method of regarding the phosphorus as the essential fertilising constituent in basic slag, although he admitted that a silico-phosphate might have a special fertilising value and that the basic nature of the slag was important.

The question of enriching basic slags poor in phosphate was next considered. Two methods were suggested: (1) fractionation of the slag so as to concentrate the phosphorus as much as possible in one part of the slag; (2) enrichment of the slag by adding finely ground mineral phosphate in the ladle.

The discussion which followed dealt with the very serious manufacturing difficulties which would arise in giving effect to Dr Russell's proposals.

Sir Thomas H. Middleton, K.B.E., followed with a paper on "The National Aspects of the Case for Increasing the Supplies of Basic Slag." He dealt first with the food supplied by the soil of the United Kingdom, and showed that in the period before the war (1909-13) the home supply each week would have sufficed to support the population from Friday night until Monday morning, —i.e. we had become a nation of self-suppliers for the week-end.

He next dealt with the scope there is for the improvement in pastures and described the enormous improvement which can be brought about by the adequate use of basic slag. In dealing with the effect of pasture improvement on tillage farming, Sir Thomas showed that by increasing the productivity of the pasture land it would be possible to devote a considerably larger area to tillage without reducing the numbers of live stock.

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Sir A. Daniel Hall dealt with the demand for basic slag, and Professor Gilchrist described the results of the long series of investigations on the use of basic slag carried out at Cockle Park.

Mr George Scott Robertson spoke on "A Comparison of the Effects of Various Types of Open Hearth Basic Slags on Grass-land" as a means of ascertaining the availability of the slag. The following is a summary of his results :—

1. The field trials indicate that open hearth basic slags provide a valuable source of phosphoric acid on soils very deficient in this ingredient, and that these slags can be very profitably used for the improvement of our heavy clay soil pastures and meadows.

2. The laboratory and field results both suggest that open hearth basic slag is not a uniform material, and that important differences may exist between two open hearth basic slags of similar solubility. One may succeed, whilst the other produces poor results.

3. Solubility according to the citric acid test is no criterion, nor yet an approximate indication of the fertilising value of open hearth basic slags compared with high citric soluble basic slags.

4. It is eminently desirable that several series of field experiments on both arable and grass land should be carried out over a period of years with as many different types of open hearth basic slag as can be conveniently procured. It cannot be too often emphasised that they contain a new type of phosphate, and much more information than at present exists is necessary, as well as desirable.

5. It has often been stated that the foundation of a permanent system of soil fertility depends more than anything else upon an adequate supply of phosphates. In view, therefore, of the increasing agricultural demand for phosphates, it is advisable that consideration should be given to the feasibility of grading up the phosphoric acid content of the lower grades of open hearth basic slag in such a way that it may be economically possible to place them on the agricultural market.

Other papers dealt with the "Solubility of Basic Slags," and "Various Modifications of the Methods of Steel-making."

A general discussion followed, in which many points of interest were dealt with, and the meeting concluded with the unanimous adoption of a resolution recommending "the Ministry of Agriculture and Fisheries to create, in consultation with the Iron and Steel Institute, a permanent Committee to study the Basic Slag problem, consisting of three or four steel-makers, three or four agriculturists and agricultural chemists, a representative of the Fertiliser Trade, and a representative of the Ministry of Agriculture."

IN *Nature* for 12th May last the present position regarding potash supplies is reviewed. In 1913 the world's consumption

Potash Supplies. of potash (calculated as K_2O) was about 1,000,000 tons for agricultural purposes as against 135,000 tons for all other purposes. Before the war this consumption was supplied entirely from Germany, chiefly from

the mines situated in Germany proper, and to a much smaller extent from the mines in Alsace, then subject to Germany. All these mines were in German hands, controlled by the Potash Syndicate, which deliberately limited the Alsatian output to 5 per cent. of the total, in order to protect the very large capital that had been invested in the North German potash mines.

Of the world's consumption of potash in 1913, Germany used more than half, while in Great Britain the amount utilised amounted to only 23,410 tons. In that year German land received about eight times as much potash per acre as did land in this country, but our needs are less in this respect than are those of Germany, because our land is on the average much heavier than that cultivated in Germany, thus needing less potash. In Germany, also, some of the crops, such as potatoes, grown on a much larger scale than here, require more potash. There seems little doubt, however, that this country could use with great advantage very much larger quantities of potassic manurial agents than it has done in the past. The preparation of the various finished products is relatively a simple operation, so far as chemical manufacture is concerned, and the question of potash supplies is thus mainly the availability of the raw materials.

Since the recovery of the provinces of Alsace-Lorraine, France has resumed possession of the Alsatian potash deposits which underlie an area of some 200 square kilometres, and are estimated to contain about 1,500,000,000 tons of crude potash salts. The Alsatian deposits are immensely superior in chemical composition to those in North Germany. They are much richer in potash, for whereas the German crude salts average about 10 to 12 per cent. of K_2O , the French deposits contain a proportion that is variously stated as between 18 and 25 per cent. of K_2O ; moreover, the former contain a large proportion of magnesian chloride, while the latter are practically free from this objectionable impurity. In addition to the Alsatian and German deposits, there are deposits in Galacia and at Erythrea in Italy, and the recently discovered deposits in Catalonia, Spain, are likely to prove quite important. In Tunis, in Chile and in the United States, lakes rich in potash salts have been worked. Those in the last-named country occur in Central Nebraska, and produced in 1918 salts carrying 40,000 tons of K_2O .

In this country the only practically available source of supply is the flue-dust from blast-furnaces. The amount of potash obtained has, however, been small, and has also been very variable, depending largely on the working of the blast-furnaces. As the result of a number of experiments it has been discovered that by adding a small proportion of salt to the blast-furnace charge, practically all the potash present can be volatilised as chloride and recovered in the flue-dust. The ores richest in potash are the bedded ironstones of Secondary age, and when salt is added to the charge of a blast-furnace smelting these ores, flue-dusts are obtained that contain 30 or 35 per cent. of K_2O as chloride or other water-soluble salts. Such dust is, therefore, considerably richer in potash than the ordinary manurial salts hitherto supplied from Germany. The experiment of adding salt to the blast-furnace

charge has as yet been tried in only a few works, but it has been calculated that, if the salt process were adopted in every blast-furnace in Britain, potash equivalent to 50,000 tons of K_2O could be recovered annually. This figure is about double that of the British consumption of potash for agricultural purposes before the war, but there does not appear to be the slightest prospect of the figure being reached for many years to come, and, in any event, it falls far short of the amount really required.

Meantime, British agriculture needs potash most urgently, and it is suggested that the best policy in the national interest is to help France to develop as speedily as possible the potash resources of Alsace, and to obtain from her the supplies of potash which our lands, neglected in this respect during the war, so sorely need.

A leaflet, No. 335, issued by the Ministry of Agriculture and Fisheries, deals generally with potash fertilisers and contains suggestions as to the quantities to be applied to the various crops. Copies of this leaflet may be obtained by residents in Scotland on application to the Secretary to the Board of Agriculture for Scotland, 29 St Andrew Square, Edinburgh.

IN view of the attention recently devoted to the value of sunflower silage, the following extract from an article by W. H. Hicks,

Ensilage.

Superintendent of the Agassiz Experimental Farm, should be of interest. It is worthy of note that peas and oats, a mixture well adapted to Scottish conditions, formed a silage which came well out of the comparison.

"During the past seven years we have fed approximately 3153 tons of silage. This amount was made up of—

1675 tons maize.

1080 tons clover.

345 tons pea and oat.

And last year we grew and fed 53 tons of sunflower silage. Samples of each of the three former varieties of the 1917 crop were analysed.

Maize yielded24·04% dry matter.

Clover yielded25·11% dry matter.

Pea and oat yielded27·67% dry matter.

Sunflower yielded29·33% dry matter.

The dry matter is what is left after the moisture is removed, and represents the feeding value of the product. The analysis of the dry matter is shown as follows :—

COMPOSITION OF DRY MATTER.

Variety of Silage.	Crude Protein.	Crude Fat.	Carbo-hydrates.	Fibre.	Ash.
Maize	8·30	2·49	59·81	24·80	4·60
Clover	14·41	2·41	40·36	36·39	6·43
Peas and Oats . .	7·94	2·30	46·81	36·30	6·35
Sunflowers*	12·09	4·29	41·6	26·92	12·1

The figures given for the sunflowers were secured by averaging results of several samples analysed by the Dominion chemist.

It might be well here to say just a few words with regard to how we feed the experimental cows and how we secure our data. The cows were fed hay only during one experiment, grain was fed at the rate of one pound for every three to four pounds of milk produced. The silage was mixed with roots and straw when the two latter feeds were on hand, but in some of the trials silage was the only roughage fed. One kind of silage was fed during a two weeks' period. The next period a different silage was fed, while the third period was the original one again. Figures were used only of the second week of each period, and the results were averaged for periods one and three and compared with period two.

In feeding this way it was hoped to eliminate the tendency of the cows to gradually decrease in milk flow as the lactation period advanced, exclude as much as possible complications sure to follow after a change of feed and lessen the effects of the individuality of the cow.

Taking the average results from the four experiments, maize produced butter-fat '761 cents per pound and milk 3'905 cents per hundredweight cheaper than clover.

The average results of the four trials show that pea and oat silage produced butter-fat '61 cents per pound cheaper than maize, while milk was produced '164 cents per hundred pounds cheaper when maize was fed.

Only one test has been carried on to date with sunflower silage. The cows gave almost a pound of milk per cow per day more when fed maize than fed sunflowers. Although the percentage of fat was slightly greater when the sunflowers were fed, the difference was not sufficient to make up for the extra quantity of milk given, as the cows produced '007 pounds of fat more per cow per day when fed maize. With the same value on the two silages maize produced the cheaper milk and butter."

THE institution at Edinburgh of a station for research into problems of animal breeding was first considered in 1913, when an arrangement was come to between the **Research in Animal Breeding.** Development Commission and the Board of Agriculture for Scotland. In June of that year a Joint Committee representative of the University and the College of Agriculture was formed, and certain decisions were thereafter arrived at regarding the kind of organisation which was to be set up. Owing to the outbreak of war the work of the Joint Committee was suspended, and it was not until toward the end of 1919 that it was found possible to resume it.

In view of the unsettled conditions at the time, the Committee, with the consent of the Development Commission and the Board of Agriculture, decided to begin operations on a reduced scale and to extend the work gradually as events might justify this. Dr F. A. E. Crew was appointed head of the station, and an un-

ambitious scheme of work was submitted to and approved by the Government departments concerned.

Suitable office and laboratory accommodation has been provided by the University in a disused block of buildings in High School Yards. The rooms have been economically equipped and are now occupied.

The work of the station will consist of research into the problems of animal breeding, conducted by investigators trained in methods of genetic research. In order that scientific inquiry may be of the utmost practical value, it is essential that there should be an active and sympathetic co-operation between the experienced stock-breeder and the trained laboratory worker.

From the agricultural point of view the situation of the headquarters in the heart of the city may appear to have obvious disadvantages; but on the other hand its proximity to the University, the College of Agriculture and the Royal (Dick) Veterinary College to a large extent outweighs the disadvantages, since it will permit that easy reference to these institutions which is so necessary in research work. Moreover, much of the work is of such a character that it must be carried out in a well-equipped laboratory, furnished with conveniences which can be obtained only in a city.

A certain amount of supplementary breeding-work with the smaller quickly-breeding animals will be conducted, but the intention is to take full advantage of the experimental breeding which every stock-breeder is constantly carrying out in the ordinary course of his practice. It is not necessary to repeat experiments made by the experienced stock-breeder, provided that the results of such experiments have become known; but, on the other hand, there are many problems still unsolved, and some of these at least will be taken up.

It is proposed to build up gradually a "clearing-house" of experience in which every animal breeding record, British and foreign, will be filed, so that full information may be available in response to inquiries from those interested. There is a great need for such a record being made available, but to secure the utmost utility for it the sympathetic co-operation of the practical breeder is indispensable.

It is hoped that at a later stage facilities for experimental work will be provided on an institutional farm, and there the more special investigations will be carried out. In the meantime this must wait, until the need is recognised and endorsed by practical farmers.

As the work grows, and as the station develops, it is hoped that the staff may be strengthened by the addition of specialists in the various branches of scientific work related to breeding. A complete staff should include specialists in Embryology, Cytology, Biochemistry, Comparative Pathology, and Statistics, as well as an experienced stockman.

The main part of the work now in progress is a micrological study of the fleece of primitive sheep, this being part of a concerted investigation into the possibility of improving the wool of the modern hill sheep. The results of this study will be published shortly.

A similar study of the fleeces of the Blackface-Southdown and Siberian-Shetland crosses belonging to the Board of Agriculture is also being made, and the development of the fleece of the Blackface is being investigated.

In the immediate future it is proposed to take up the problem of temporary and permanent sterility in horses, cattle, sheep and pigs. A start has already been made with an investigation into the matter of Cryptorchism.

It is hoped that the agricultural community will recognise that the success of the work lies largely with them, and that there is in it great possibility of service to the stock-breeding industry. Information concerning the station and its work will be gladly given at all times, and accommodation will be provided as far as possible for anyone who wishes to undertake a piece of approved research. It is particularly requested that stock-breeders will give information regarding any unusual phenomenon in connection with their breeding operations, so that a concerted investigation may be undertaken; and that any specimen exhibiting an interesting abnormality, especially of the reproductive system, should be offered for examination and preservation.

THE operation of the scheme conducted by the Board of Agriculture for Scotland for the inspection and certification of potato crops of the immune varieties has shown that

Leaflet on Immune Varieties of Potatoes. farmers generally are handicapped in securing the purity of their crop owing to lack of knowledge of the distinguishing characteristics of the immune varieties and of the various "rogues." With a view to assisting growers in overcoming this difficulty, the Board have issued a pamphlet which deals fully with the "roguing" of potato crops. In this publication a detailed description of the various characteristics of the tuber, foliage and flower of the immune varieties of potatoes is given, together with particulars of the "rogues" which are commonly found in crops of these varieties.

The pamphlet will be found useful and instructive by all who are interested in potato growing, and should in particular prove most helpful to farmers and seed potato merchants who have applied for the certification of their immune crops this year.

Copies of the pamphlet are obtainable on application to the Secretary of the Board at the price of 6d. each, post free.

THE Area Study Meetings which are taking place in Edinburgh, Aberdeen and Fort William this summer will give Institute

Scottish Women's Rural Institutes. members an opportunity of attending short intensive courses in different aspects of their work, both as housewives and as members of the rural community. The Study Meetings had their origin in requests from the north-western, north-eastern and south-eastern area committees that the Board of Agriculture for Scotland should arrange for instruction, provided that there was a sufficient response from the Institute members. The central area com-

mittee are to be responsible for all arrangements in connection with the Women's Institute Exhibit at the Highland and Agricultural Society's Show this year, which involves considerable effort on the part of the Institutes, while in the south-western area Institutes began at a later date than in other areas, hence the decision to hold this experiment in the centres already named.

The course at the Study Meetings includes a short series of lectures on women's place in the rural community with especial reference to Institute work at home and abroad, and its relation to that of other bodies, voluntary and official. There will also be a series of demonstrations on utilising the produce of the garden and farm for the household, on the lines of the very successful course held in connection with the Conference in 1919. An alternative series of demonstrations will be given on the home-crafts by means of which things which are to the hand of the country woman may be utilised for adding beauty to the home, thus saving what might otherwise be wasted. This course will include skin-curing and fur-craft, willow basket-making, chair-caning and stitchery. Institute members will contribute their quota to the meetings in a series of short papers on the Institute as it should be, both as regards the personnel of members, committee and office-bearers, and the meeting-place and its accessories. Members in Aberdeen will have the privilege of hearing Professor Arthur Thomson, and of visiting the experimental station at Craibstone and the Domestic Science Centres. In Edinburgh there will be an exhibition of handiwork at the College of Art. In all the three areas the committees are arranging that time shall be given for social meetings and interchange of ideas as well as for class instruction. The response to the suggestion of Study Meetings testifies to the vitality of the Institute movement. There will be an attendance of from 100-200 members in each centre, and a large number of Institutes are paying for the expenses of two members in order to ensure that they have the benefit of reports and instruction from these on their return.

The annual meeting of the National Federation of English and Welsh Institutes was held in London on the 3rd and 4th of May, when over 800 delegates were present. The meeting was a most satisfactory one, and showed that the Institute movement had made considerable advancement in all directions.

THE weather during March, April and May was, on the whole, favourable for outdoor work and, with few exceptions, cultivation proceeded satisfactorily. The rainfall in the eastern and north-eastern districts during the three months was unusually low, but more rain fell in the western and south-western counties, especially during March and April. Cold winds and frost in May checked growth to a greater or less extent, and even in June night frosts were frequent in several districts. Fruit trees have suffered considerably owing to frost, and the abnormally dry weather has affected the hay crop to such an extent that the bulk will be more or less below the average.

Agricultural Conditions.

The wheat crop has progressed normally in most cases and is generally vigorous and healthy. It is satisfactory to note that up to the present the crop is free from the bulb-fly which was so prevalent in April and May last year, and which caused such widespread damage. The acreage sown is estimated to be about 57,000 acres, showing an increase of 3000 acres as compared with last year.

Barley is generally reported to be looking well, but in Moray and Berwick the crop is said to have suffered to some extent owing to lack of moisture. The estimates of acreage sown indicate a decrease in the great majority of the districts, the total area being estimated at 192,000 acres, or fully 12,000 acres less than in 1920.

The reports show that oats are the least satisfactory of the grain crops. On light soils growth has been slow owing to lack of rain, and considerable damage has been caused by grub in many districts. The area sown is estimated to be greater than that of last year by about 17,000 acres, and to amount to a total of 1,040,000 acres.

Beans are everywhere reported to be doing well. Rye-grass and clover seeds are making fair progress, but growth has been slower than usual owing to lack of moisture.

Potato planting was practically completed at the end of May, and the crop is generally reported to be very promising. The total area is estimated at 151,000 acres, or 11,000 acres less than in 1920. The sowing of turnips and swedes was well advanced at the beginning of June, and the sowing of mangolds was finished.

The fruit reports are rather unsatisfactory and the present prospects are not very promising, especially in Perth and Lanark. In Stirling, however, fruit generally promises to be a fair crop.

All classes of live stock have made satisfactory progress during the spring. The lambing reports are especially satisfactory. Both on arable and hill farms the crop of lambs was well above the average, with twin lambs more numerous than usual. Considerable losses among lambs have occurred in Kirkcudbright and Wigtown owing to scour; in Kincardine a high death-rate is recorded from "wool-ball" and in Roxburgh from "joint-ill," while in Central Argyll there have been losses owing to the depredations of foxes.

The supply of regular workers is now generally sufficient, and in some cases is in excess of requirements. Specially full reports on labour were obtained at the end of May in view of the hiring fairs that were held in many districts during that month. The wages being paid are described in detail in the Monthly Agricultural Report for 1st June, and it will be observed that wages generally show a downward tendency.

It is regretted that in the letterpress under the photograph of the pony stallion "Atholl" which appeared with the article on

Correction.

Highland Ponies in the *Journal* for April it was erroneously stated that the pony was bred at Blair-Atholl. The pony, as also its dam, Gaick Calliag, was bred at Gaick Forest, Kingussie.

RECENT PERIODICAL LITERATURE.

The majority of the following extracts and summaries are taken from recent bulletins of the International Institute of Agriculture. Full references to the bulletins, and to the original publications quoted therein, may be obtained on application to the Secretary, Board of Agriculture for Scotland, 9 St Andrew Square, Edinburgh.

The Nutritive Value of the Wheat Kernel and its Milling Products.

1. B. Osborne and L. B. Mendel, *Jour. of Biol. Chem.*, Baltimore.—The authors undertook a detailed study of the composition and nutritive value of the wheat seed and its milling products from the particular point of view of the problems arising from modern milling methods and the yield desired of the products for general use. They review the literature on the composition of the embryo, the outer seed coats or bran, the endosperm and the whole seed, and they give the data extracted from this literature or obtained from their own investigations.

For the most part, the experimental work of the authors consisted in a long series of experiments on rats, to reach a quantitative comparison between the entire wheat kernel and its milling products with respect to the nutritive value of their proteins and their content of water-soluble vitamine, both for the maintenance of adult rats and the growth of young ones. The results of these investigations may be summarised as follows:—

The proteins of the wheat kernel are not greatly inferior, for maintenance, to casein or even to the total proteins of milk, but are somewhat superior to gliadin. They are adequate for promoting the growth of rats to normal adult size, but the quantity of protein required for growth is relatively large. The crude protein of commercial wheat embryo flour appears to be more efficient than that of the entire wheat kernel for maintenance, and much more efficient for growth. The crude protein of wheat bran has a higher value for growing animals than that of the embryo, and is as efficient as that of the combination of wheat flour with egg, milk or meat. Hence the agriculturist is justified in his high estimate of the value of wheat bran as a protein concentrate.

The protein of the endosperm was adequate for the maintenance of adults but not for growth, even when the intake was large. A diet containing only 10·3 per cent. of protein furnished by flour supplemented with egg, milk or meat produced more rapid growth than a diet containing even 50 per cent more protein derived entirely from the wheat flour. This shows that, under ordinary human dietary conditions, the proteins of wheat are advantageously employed.

Commercial wheat embryo is much richer in water-soluble vitamine than commercial bran and flour. The pure embryo, carefully separated from all the other parts of the seed and used as the sole source of vitamine suffices to maintain young rats but fails to promote their growth. Wheat kernels from which the embryo has been carefully removed are still rich in water-soluble vitamine. Following on these observations the authors raise the question of whether the water-soluble vitamine is a single substance or a mixture of two or more. If it is a single substance it must be a constituent of the endosperm.

Rats fed for one year from the time of weaning on diets containing 92 per cent. of wheat or 50 per cent. of commercial wheat embryo reached full maturity without giving any evidence that wheat contains a toxic substance.

Applying these results to the question of the degree to which it is desirable to mill flour, the authors conclude that, except in special cases, little can be gained by including bran and embryo in the flour when this is used for human food under the conditions prevailing in the United States, where the greater part of the flour consumed is taken along with other foods which make good the nutritive deficiencies of its protein better than would be done by the proteins of embryo and of bran. Again, considering that the rations of farm animals require protein supplements and that wheat bran is a good source, the by-products of milling will be better utilised as food for animals than for man. Besides, as about 80 per cent. of the wheat kernel can be so improved in nutritive value by adding animal products to the diet that a

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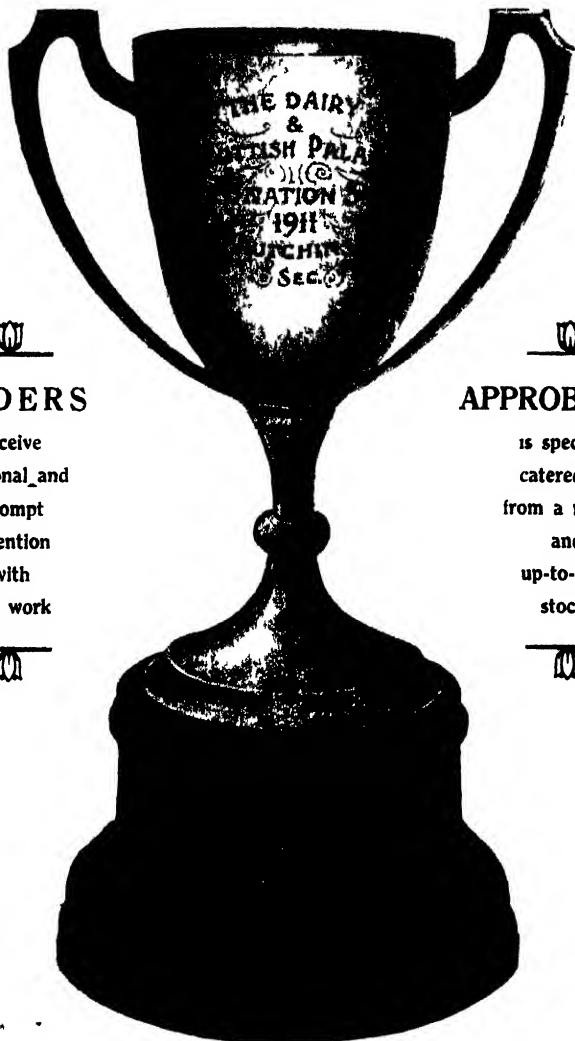
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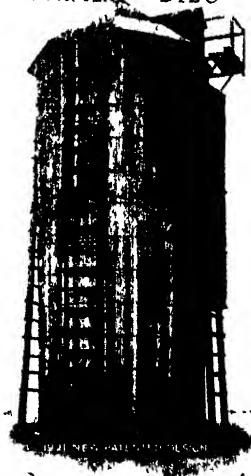
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much smaller amount of flour will satisfy the protein need of nutrition, it may well be that the use of the by-products of milling for the production of meat, milk, or eggs will result in a greater economy in the use of flour than if these were used directly for human food.

The Composition of Cereal Grains: Aleurone. *I. G. Vareschi, Turin.*—The author examines critically several of the commonest treatises on botany, showing their mistakes regarding the location and nature of the chemical constituents of wheat and rice grains. He makes out that several authors confuse between aleurone (a mixture of albuminoids not yet well defined and separated) and gluten (a mixture of at least five albuminoids, among which glutenin and gliadin, especially the latter, are typical), and he draws the following conclusions from his work:—

- (1) True gluten is found only in wheat and rye grains.
- (2) The albumen or kernel of wheat, rice and the other cereals contains not only starch but also always albuminoid material (gluten and non-gluten).
- (3) The gluten, whether previously formed or not, exists with the starch in the albumen and not in the so-called "aleurone" layer, and in much more minute quantities in the outer coats. In wheat-seed albumen, starch does not exist alone, but is always associated with gluten. The quantity of gluten increases from the middle towards the outside of the albumen; it has not yet been proved whether the gluten pre-exists in the albumen or is formed by the action of water.
- (4) It is easy to separate gluten from starch in wheat, but difficult to separate albumoid from starch in rice.
- (5) It is erroneous to state that aleurone is synonymous with gluten.
- (6) The term "aleurone" should be abolished, so as not to cause confusion, and replaced by the generic name "albuminous or protein matter."

A Review of the Literature on Tillage. *M. C. Sewell, Jour. of Amer. Soc. of Agron.*—The heaviest expense in producing cereal and annual forage crops is on account of tillage—ploughing and cultivation. The depth and frequency of ploughing, the number of weedings have a material influence on the cost of production of a crop. The prevailing opinions on the subject are, however, so conflicting that a review of the literature relating to it is most opportune. After recalling to mind the forerunners (Tull, Priestley), then the classic agriculturists of the nineteenth century, and lastly modern authors, the author points out that the prevailing theories regarding deep and frequent ploughing are not founded on experimental data, and he formulates the following conclusions:—

- (1) Ploughing deeper than seven inches does not generally cause an increased yield.
- (2) Shallow ploughing may produce as great yields as deeper ploughing, but the depth less than seven inches which is best for economic production has not been determined.
- (3) There are not sufficient data to determine the expediency of frequent ploughing, but it appears that a suitable rotation of crops enables the number of ploughings to be decreased.
- (4) Cultivation may be necessary only to extirpate weeds or to put the soil into condition for absorbing rainfall; it is therefore practical, except in very heavy soils, to reduce the amount of cultivation where it is intended primarily to maintain a soil mulch.
- (5) Many soils have naturally sufficient aeration, without cultivation, to ensure optimum bacterial and chemical activity.

Numbers of Protozoa in the Soil. *D. Ward Butler and L. M. Crump, Ann. App. Biol.*—The significance to agriculture of the presence of micro-organisms in the soil is a matter that has not yet been fully determined, but constant observation and experiment at Rothamsted is adding very considerably to our knowledge of the habits of these minute creatures. Earlier investigations have shown that the numbers of flagellate protozoa

in the soil vary during the year, and that moisture and temperature have apparently nothing to do with the fluctuation, though the addition of manure to the soil resulted in a great increase of numbers seven days afterwards. Now it has been shown that the numbers of active flagellates vary daily in a see-saw rhythm which the authors suspect may be connected with reproductive periodicity. So marked is the fluctuation that while on one day 12,000 individuals were found in a gram of soil, on the succeeding day none were discovered, though on the day next following 19,000 were again present. The numbers of flagellates in the soil showed no relationship to the numbers of bacteria, but there was a distinct relationship between the numbers of the latter and those of active amœbæ, the number of which seem to determine those of bacteria a fortnight later.

Crop Succession and Frit Fly. *F. R. Petherbridge, Ann. Appl. Biol.*—Experiment as well as field observation seem to show that the intensity of frit fly in wheat crops depends greatly upon the crop which has preceded the wheat. It was noticed in successive years that bad attacks in winter wheat almost invariably followed leys containing rye grass or Italian rye grass; and experiments were carried out to test and explain these observations. The results confirm the field observations, and the reason is that the autumn brood of frit fly lays its eggs on the grass, on the shoots of which the larvæ feed, afterwards migrating to the young wheat plants when the grass has been ploughed in and the field sown. The damage done by the maggot seems to be much greater on a loose than on a compact tilth, and this the author attributes to the fact that on the former the plants do not tiller so rapidly and are more likely to die under attack. He has never seen appreciable damage done by frit to wheat following potatoes, beans, corn or fallow, but the indications are that if these contained or were followed by gross weeds in autumn, then the wheat succession might be attacked. The attack of frit after fallow may be avoided by bastard fallowing, though this makes the wheat liable to the wheat-bulb fly—a choice of two evils which the author leaves the farmer to decide for himself.

Wheat-Bulb Fly. *F. R. Petherbridge, Jour. Agr. Sci.*—The great damage caused by the wheat-bulb fly in several parts of Scotland suggests that close watch should be kept on observations which lead to fuller knowledge of the pest. The author thus summarises in *Entom. Mon. Mag.* for April the results given in detail in the paper referred to above, of his experiments on Cambridge University Farms. The flies hatch out in June and July, and lay their eggs in bare soil about one-eighth of an inch below the surface in July, August, and possibly September. Most of the eggs hatch out in the following spring, as they are usually found in wheat plants in March and April. A few may, however, hatch out the same autumn. The larva on hatching from the egg makes its way into the middle of a wheat shoot, where it feeds at the base of the shoot, which it kills. When fully fed the third-stage larvæ make their way into the soil, where they pupate about one and a half to two inches below the surface. Pupation usually takes place in May.

How Plant Bugs damage Vegetation. *K. M. Smith, Ann. App. Biol.*—A capsid bug, *Plesiocoris rugicollis*, destroys leaves and fruit of apple-trees by puncturing them in order to suck the juices within, and causing thereby pronounced distortion, check of growth, and "russeting," which ruin the fruit and do some damage to the tree itself. Experiments were conducted to determine whether the damage was due to the mechanical perforation of the plant tissues by the bug, to the chance introduction of bacteria with the bug's saliva, or to the infection of a poisonous secretion from the salivary glands. Artificial mechanical punctures produced no damage comparable to that caused by the bug, no bacteria were found to be present in damaged plant tissue nor in the bug's salivary glands, but a long series of observations on the action of dilute poisons on plant tissues, and of experiments with active bugs on different kinds of plants showed that the damage was due to the presence in the salivary glands of some toxic substance which produced violent effect upon the cells with which it came into contact.

Pheasants and "Leather-Jackets." *The Field.*—A reproduction is given of a striking photograph of the contents of a pheasant's crop. The

bird was found trespassing in market gardens near Uckfield, Sussex, and was shot. Examination showed that it had been devouring the "leather-jacket" grubs of crane-flies, of which 1083 individuals were found within it.

Changes in Composition of the Soil and of the Water Extract of the Soil following Addition of Manure. P. L. Hibbard, *Soil Science, Balt.*—Fresh manure was mixed with loamy soils in the proportion of 1, 2 and 5 per cent., the mixtures were kept at optimum moisture point and analysed, during the year, from time to time.

It was found that carbon dioxide in the soil atmosphere was increased in proportion to the manure added, but, in the year's trial, the carbon decreased, while the nitrogen remained constant. Water-soluble matter at first decreased, as compared with untreated soil, then increased, but without ever equalling the sum of that in the soil plus that in the added manure. Nitrate quickly disappeared, and later reappeared and increased in proportion to the manure used.

The above, in short, is a confirmation of the fact that fresh manure should not be added to a soil just previous to or during the time a crop is growing. It should be remembered, however, that these experiments were made with glass jars.

The Influence of Fertilisers on the Botanical Composition of Pastures in the U.S.A. J. Skinner, *Soil Science, Balt.*—A pasture on loam soil received for seven consecutive years superphosphate, sodium nitrate and potassium chloride in a double triangle arrangement of plots with 66 mixtures of fertilisers plus 6 controls, the total amount of fertilisers applied annually was 50 pounds per acre; the plots were 10 feet square and were separated by 2-foot paths; the grass was cut once a year so as to allow natural seeding. The principal forage plants were:—*Poa compressa*, predominant at the commencement, *P. pratensis*, *Phleum pratense*, with smaller proportions of white clover and red clover. At the end of the experiment *Poa pratensis* had become predominant, especially in the plots which had received most nitrogen, while *Phleum pratense* was favoured by potash; clover, however, did better in the plots where there was least nitrogen applied.

The soil of the plots receiving well-balanced mixture or mixtures containing principally sodium nitrate remained neutral, whilst when no nitrogen, or only a small amount, was applied it became acid; this, however, did not hinder the growth of clover, although in such cases it is favoured by liming.

To sum up, the predominance of a given species of forage plant in a pasture is very probably due to the survival of those species which the fertiliser applied suits best, such fertiliser being possibly at the same time prejudicial to other species.

The Action of some Common Fertilisers and Manures. J. E. Greaves and E. G. Carter, *Soil Science, Balt.*—After a full account of the works hitherto published in scientific literature on the various soil amendments and stimulants, the authors report some laboratory experiments on the action of various salts on the nitrogen and phosphorus of the soil in their various forms.

It stands confirmed that the sulphates of magnesium and calcium, the chlorides of sodium, potassium, magnesium and calcium, the nitrates of potassium, calcium and magnesium, also the salts of manganese and iron generally, can be efficient stimulants of soil fertility.

The stimulating action would be due, in certain cases, to an increase of available phosphorus in the soil and in others to an increase in nitric nitrogen, increases caused by the action of the salts in question and sufficient to explain the additional yield corresponding to their application. A remarkable increase is that of nitric nitrogen, which, in the case of sulphate of calcium, may be as much as 97 per cent. The increase of available phosphorus, either in the form of soluble phosphoric acid or in the form of organic phosphorus, was noted in all cases but two—namely, with nitrate of manganese and with carbonate of magnesium. The maximum increase in soluble phosphoric acid was caused with nitrate of magnesium (15.5 per

cent.) the increase in organic phosphorus was greatest with carbonate of manganese (6.26 per cent.).

While sulphate of calcium is the strongest stimulant for rendering more nitrogen available, carbonate of manganese acts similarly for phosphorus in the combined increase of its two forms (soluble phosphoric acid and organic phosphorus).

Nitrogen Losses in Urine. *F. E. Bear and J. R. Royson, Jour. of Amer. Soc. of Agron.*—More than half the nitrogen of farmyard manure is contained in the urine, hence the interest of the research undertaken by the authors on the losses of nitrogen in the urine of farm animals, more especially because many agriculturists usually keep the urine in tanks until the time when it is sprinkled on the fields. The expediency of keeping the liquid portion of the manure in this way having been much debated, the authors investigated the losses of nitrogen from urine—(a) exposed to the open air; (b) in Bunsen valve flasks; (c) in closed flasks; (d) in closed flasks but with the air replaced by carbon dioxide; (e) absorbed in litter (replaced for the experiment by filter paper); (f) covered with a layer of kerosene. These experiments showed that urine exposed to the air lost over 92 per cent. of its nitrogen in 8 weeks under temperatures averaging 38° C.; under temperatures averaging 5° less the same loss took place in 12 weeks. Urine not exposed to air lost on the other hand little or no nitrogen. Regarding the method of preventing loss of nitrogen by absorption in litter the effectiveness depends on the manipulation; when the litter was allowed to dry there was a loss of 20 per cent. of nitrogen, but when it was kept moist the loss was 97 per cent., the maximum observed in the different experiments. The use of kerosene for covering the urine is a good means of preventing loss of nitrogen, for in this case the losses were not greater than 6 per cent. during 8 weeks.

The Comparative Value of Various Forms of Agricultural Limestone. *R. Stewart and F. A. Watt, Soil Science, Balt.*—The beneficial effect of liming, and specially the great value of ground limestone on acid soils, has been fully realised in the United States only within the last few years. There are some questions, however, regarding the use of limestone which remain to be settled:—

- (a) Can dolomitic limestone be used successfully on acid soils and what is its value compared with limestone containing a high percentage of lime?
- (b) What is the comparative value of finely ground limestone and coarse limestone?
- (c) What is the duration of the action of various kinds of lime applied to soils?
- (d) What effect has the application of limestone on the surface upon the acidity of the subsoil?
- (e) What is the annual loss of lime from the soil and what are the factors in such loss?

The authors' experiments, made on acid soils, have enabled them to prove that, after the initial acidity has been neutralised, an application of 1 ton per acre of limestone is sufficient to keep the soil alkaline for 4 years, and that dolomitic limestone is equally effective. There is no difference in the effect of finely ground and coarsely ground limestone; the latter is even better retained by the soil. Limestone applied on the surface penetrates slowly and, after many years, reaches a depth of 6 to 20 inches, but never gets down to the subsoil. The annual loss of lime from the surface layer 20 inches deep varied from 542 lbs. to 760 lbs. per acre. Among the causes of loss, other than the state of the limestone applied, as has been indicated above, are the amount of limestone and its nature. There always remains some lime in the soil which does not act on the acidity, so that the loss of lime may be less than is indicated by acidity determinations.

Lime Requirements in the Soil Determined Chemically and Physiologically. *B. L. Hartwell, F. R. Pember and L. P. Howard, Soil Science, Balt.*—Experiments made with lettuce and beet (lime-loving plants) in pots con-

taining a normal soil which had received a copious application of nitrogen, phosphoric acid and potash, plus varying amounts of slaked lime. Liming caused an increase in the yield, but after a certain yield was reached, further liming did not increase growth, although the lime requirement of the soil was chemically still considerable. The addition of superphosphate to unlimed pots caused an increased growth in lettuce in spite of a markedly increased lime requirement in the soil as determined by chemical examination. This tends to show that the elimination of the effects of alumina in acid soils is of greater importance than the neutralisation of the acidity.

The "Maoinlin" Breed of Cattle in Ireland. *S. L. Mitchell, Hoard's Dairyman.*—The Irish "Maoinlin" breed of cattle, hornless, with dark brown-yellow coat, generally whole coloured, sometimes spotted white on the head and shoulders, is very ancient, and at the present time there are only 8 or 9 herds. Several skulls of animals of this breed have been found in the "crannogues."¹

According to some writers, the native home of this breed stretches east of the Shannon through Longford, Westmeath, King's County and Tipperary; at the present time it is found chiefly in the west part of the island, from Donegal to Cork. The distinctness of the breed is shown by the fact that, however much crossed, it is dominant and recognisable even to the tenth generation. It is due to this fact that the breed is not to-day entirely extinct. A society has been formed for re-establishing this breed.

"Maoinlin" cows are excellent milkers; they give from 8 to 10 gallons a day in summer and 4 or 5 gallons a day in winter of delicious rich milk. They are not liable to any disease. According to the author the hornless character of some of the present Scotch and English breeds may be due to cattle introduced into East Anglia and Scotland by early Irish colonists.

Mineral Nutrients and Maize in Swine Feeding in Kansas, U.S.A. *Kansas Agric. Expt. Stn. Report.*—In order to study the importance of mineral nutrients in swine feeding, 90 Duroc-Jersey pigs were divided into 15 lots, and fed on maize, with various ash and protein supplements. Bone ash was a valuable addition to all rations tried, except those containing tankage, when it proved detrimental. A ration of maize meal and alfalfa pasture did not supply all the mineral required for young fattening pigs.

Six pregnant Duroc-Jersey sows, fed on maize only, and three fed on a similar low-ash ration composed of ground maize, wheat gluten and blood-meal produced small litters of poorly developed pigs, half of which were dead in 30 days. The sows were generally in poor condition, and two died about 5 weeks after farrowing. Two control lots, comprising 3 sows each, were fed on a mixture of ground maize 70 parts, shorts 24 parts and tankage 6 parts, with or without extra mineral matter, and produced healthier pigs that grew more vigorously and showed a lower death-rate.

Study of the influence of low-ash rations on pregnant sows was made in 1918 with 14 animals, 10 being survivors of the preceding year's work. Eight sows fed on ground maize alone, with either tap or distilled water, produced 14 dead pigs and 39 living ones, of which only 6 lived for 2 months. Three sows fed on maize, maize gluten-meal and blood-meal produced 21 dead pigs and no living ones. Three sows fed on maize, shorts and tankage produced 1 dead pig and 21 living ones, all still alive at weaning, 60 days afterwards.

Study of the effect of protein and ash supplements to maize in the fattening ration was made with 66 Duroc-Jersey pigs, weighing at the start about 45 lbs. a head and divided into lots of 6 each. The feeding methods are judged largely by the time necessary for the pigs to gain 150 lbs.

Seven lots were fed on alfalfa pasture, and 4 in dry lots. Of the 7 former, the 3 lots in which maize was the only concentrate took longest (104 to 107 days) to attain the desired weight. Additional ash had no apparent influence. The most rapid gains (97 days) were made by a lot given 6 per cent. of the concentrate as tankage and which had access to extra mineral nutrients. A lot in which shorts and tankage (4:1) formed 20 per cent. of

¹ A kind of block-house used in ancient times as fortresses by Irish chiefs—generally built on islands.

the grain ration gained 150 lbs. per head in 90 days. Two self-fed lots, one with maize, shorts and tankage and the other with maize, tankage and additional ash, required 100 and 101 days respectively. Three of the lots not on pasture received shorts and tankage (4 : 1) as supplement to maize. A feeding period of 112 days was required for two whose grain rations were 70 and 60 per cent. maize respectively, and a period of 105 days for the other in whose ration the proportion of maize was gradually changed from 40 to 80 per cent. The fourth lot not on pasture had free choice of maize, shorts and tankage and needed 104 days' feeding. Shorts and tankage were consumed approximately in the proportion 8 : 1 and formed about 30 per cent. of the ration.

Hæmorrhagic Septicæmia. *H. J. Washburn, U.S. Dept. of Agric. Bull.*—This bulletin deals with the following points:—Characteristics of this Disease; History; Causes; Symptoms; Anatomical Changes which it Causes; Diagnosis; Prevention; Treatment; Disinfection of Premises.

Hæmorrhagic septicæmia is an infectious disease which attacks various species of animals, especially cattle, sheep and pigs. Young animals are more susceptible to it than older ones; those which are thin and poorly nourished are most liable to infection. The disease is a poisoning of the blood which often rapidly proves fatal. In suddenness of attack and high mortality at the beginning of an outbreak this disease much resembles anthrax.

In pigs the disease is called "swine plague" or contagious pleuropneumonia. The acute form is usually fatal within a few hours from the appearance of the first symptoms. The other form causes gradual weakening and emaciation and may last several weeks.

Fowl cholera is the form of hæmorrhagic septicæmia affecting poultry; it causes sometimes heavy losses among fowls, pigeons and geese. The outbreaks are generally so rapid in their effect that no treatment is possible. As soon as the disease appears the apparently healthy animals should immediately be segregated in clean quarters and given good food and water. In many cases inoculating the healthy animals with bacterins has proved effective in checking the spread of an epidemic.

In the United States, hæmorrhagic septicæmia occurred for the first time many years ago in the form of "swine plague." In 1885 the Bureau of Animal Industry identified the *Bacillus bipolaris suisæpticus* as the cause of the disease, identical with the "Schweineseuche" of German writers.

Curative treatment is useless. Preventive treatment by means of bacterins obtained from the same species as the animal to be treated (*B. suisæpticus* for cattle, *B. suisæpticus* for pigs, etc.), or else by means of an attenuated culture of the living organism, has often given satisfactory results. Isolation of the uninfected animals and disinfection of their quarters are most important measures.

Utilisation of Dairy By-products. *E. Kelly, Jour. of Dairy Science, Bull.*—Waste of matter may be caused (1) mechanically (actual loss), or (2) by not using it in the best possible manner (partial loss). The dairy industry unfortunately too often wastes in both ways. Only the surplus skim milk which cannot be used for human consumption should be fed to animals and ought to be much more employed than it is at present: 100 lbs. of skim milk will produce 15 to 19 lbs. of "cottage cheese," whereas fed with maize to pigs it would produce only 6 lbs. of live weight or 4·8 lbs. of dressed pork. There is, therefore, in the former case production of about 7 times as much protein and energy as in the latter. Moreover, in making "cottage cheese" 80 to 85 lbs. of whey is recovered from 100 lbs. of skim milk, and this has half the food value of skim milk for feeding pigs.

Skim milk and buttermilk can be used in that state as beverages or in cooking. One lb. of "cottage cheese" contains as much protein as 1 to 1½ lb. of meat, and can be used in a number of ways in cooking. This is one of the best ways of using skim milk because "cottage cheese" is easily and simply made, and it can be consumed in large quantities. But skim milk can also be used for making condensed skim milk and skim milk powder. Whey from cheese factories contains on the average 0·2 per cent. of fat, which can be recovered and used in the manufacture of whey butter. Lactose, casein, etc., can also be made from whey.

All the by-products of the dairy industry, if they are to be used without risk for human consumption (or indeed as animal food), should be pasteurised.

Observations on the Washing of Milk Cans. *R. O. Webster, Jour. of Dairy Science, Balt.*—An account of data collected by the Bureau of Chemistry of the U. S. Department of Agriculture (under the Food and Drugs Act) relating to the milk supply of one of the large cities of the central western part of the United States.

The author notes the methods and equipment used by 32 milk dealers in washing the milk cans: 8 of them washed the cans by pouring the water from one can to another and 22 washed the cans in a tank; only one used hot water and 2 clean cold water, while 28 used dirty water. In 23 dairies the cans were steamed, but in no case was the treatment effective, so that no dairy washed the cans in a satisfactory manner; nevertheless 3 dairies possessed what is considered to be the complete equipment: tank with mechanical brush, rinsing tank, steam jet, air blast.

Examination of the physical and bacteriological condition of 184 empty milk cans returned from the city dairy to the country dairy, made during June and July, showed that 14 cans had a sour odour and 83 a foul odour which indicated bacterial activity in these 97 milk cans. More than 21 per cent. of the cans, if used without further rinsing, would have contaminated the milk with from 500,000 to 4,332,000 bacteria per cc. of milk; milk produced in distinctly insanitary conditions rarely contains more than 20,000 organisms per cc.

To prevent this fouling of the cans they should be rapidly dried immediately after washing; this can be done by exposing the milk cans to a blast of dry air; 30 seconds' exposure to such a blast is sufficient to produce a great improvement.

The author gives the following rules for washing milk cans properly: Avoid the use of disinfectants; they are unnecessary and may remain in the cans in sufficient quantity to be found in the milk, which would render the producer liable to legal penalties.

For the proper washing of the cans a tank with clean hot water is necessary; washing powder; thorough brushing by hand or by machine; rinsing in clean water; steaming for at least 10 seconds; drying in a blast of dry, hot air of sufficient volume to dry the can completely in 10 to 30 seconds. The lids should be cleaned in the same way. As soon as they are washed and dried the lids should be put on to close the cans and prevent their being soiled. Milk cans cleaned in this way remain clean indefinitely and even in the hottest weather there is no opportunity for bacterial activity.

Bacteriology of Egg Powders. *Bull. of Ministry of Agric., Paris.*—At a meeting held on 6th January 1920 by the Academy of Medicine, Paris, the results of the investigations by Dr A. Satory and D. L. Flament on the microbic flora of dried egg powders as sold in commerce, were published. This flora is important. It is usually aerobic, and includes micrococci which do not liquefy, and others which liquefy in gelatines as well as members of the *Bacillus coli* group, etc. These powders are contaminated.

The various brands on the market are not sterilised. In the preparation of creams and many dishes, these powders are not raised to a sufficient temperature for sterilisation.

Experiments in Preserving Eggs in Italy. *M. Passerini, Florence.*—From the results of a series of experiments conducted in 1918 at the Scandicci Agronomic Institute (Florence), the author concludes that—

- (1) Eggs may be preserved dry for over 7 months, provided they have been taken very fresh, carefully washed, have had their shells lightly rubbed with fat (lard) containing 1 per cent. of salicylic acid, and have been kept in a cool dry place. The loss in weight, due mostly to the evaporation of moisture through the shell, amounted to only 5 per cent. in 231 days.

- (2) By wrapping each egg thus greased in oiled paper, the loss in weight may be reduced to less than 3 per cent. in 231 days. In both

these cases the eggs keep their taste and smell almost unaltered and the albumen remains liquid in the same way as eggs preserved in lime water.

- (3) Immersion in lime water gave excellent results ; with perfectly fresh eggs, carefully washed, and sufficiently pure lime, like that from statuary marble, this method is good for keeping eggs, in a cool place, for 14 months. The slight taste of lye which eggs preserved in ordinary lime water take on in the course of time probably depends, not on the penetration of small quantities of lime into the interior of the egg, but on impurities in the lime, especially alkaline hydrates, as this taste is not found in eggs preserved in sufficiently pure lime water. Some writers think that the liquefaction of the albumen is due to the passage of small quantities of calcium hydrate into the interior of the egg, but the author's experiments show that, even with dry preserving, this occurs. Hence it probably depends on a molecular change in the albumen in time and perhaps also on the beginning of hydrolysis of the albumen concerned.
- (4) Partial sterilisation at 60° C., before immersion in lime water did not give good results.
- (5) Dry-preserving of eggs previously heated to 60° C. and placed in closed vessels gave disastrous results, whether these eggs were or were not coated with fat or gelatin. The same result followed when the eggs were exposed to ether vapour. Probably better results would have been obtained by placing the eggs in containers sterilised by heat, but in order to keep the contents from further taint, difficulties would have been encountered which were too unsurmountable in practice.

Genetic Studies in Poultry: Inheritance of Leg-Feathering. R. C. Punnett and P. G. Bailey, *Jour. of Genetics, Camb.*—Results of experimental crosses between a breed with feathered legs (Langshan) and breeds with naked legs (Brown Leghorn and Gold-pencilled Hamburg).

Generally the F_2 fowls had slightly feathered legs ; but there was considerable variation, and one of the hens from a cross with the Hamburg breed had naked legs, and although crossed with a cock with naked legs, she produced progeny with feathered legs.

The F_2 generation of the cross with the Leghorn breed comprised 323 chickens with feathered legs and 106 with naked legs ; the F_2 generation of the cross with the Hamburg breed comprised 117 chickens with feathered legs and 31 with naked legs. There was, therefore, a close approach to the ratio 3 : 1.

Fowls of the F_2 generation were, as far as could be judged, identified as homozygous for the character "leg-feathered." A few F_2 fowls were even heavier leg-feathered than the Langshan breed. Chickens with moderately feathered legs crossed with chickens having naked legs very often produced chickens with heavily feathered legs ; in these cases a greater number of cocks were feathered in this way than hens. The author relies on the hypothesis of modifying factors to explain these facts.

On the basis of the data recorded by Davenport the writer suggests that the character "leg-feathered" in Cochinchina and Dark Brahma breeds depends on two factors.

Aspergillosis of Poultry. Hitier, *Comptes rendus des Séances de l'Acad. d'Agric.*—M. Hitier presents to the Academy a report by M. le Comte Delamarre de Monchaux on aspergillosis of poultry in which the author sums up a communication made by him to the Avicultural Section of the Société des Agriculteurs de France.

This mycosis, regarding which there is scarcely any mention in avicultural treatises, has been noticed in a great number of species: geese, turkeys, swans, ducks, chickens, pigeons, etc. Man himself is not exempt, as is proved by the pseudo-tuberculosis of pigeon feeders, studied by Rénon.

The *Aspergillus fumigatus* responsible for this disease, named in 1863 by Fresenius, had already been described and illustrated in colour by Deslongchamps in 1841.

Very common in nature in a saprophytic state it gives rise, according to the author (under the influence of causes still little known, for example of a wound which gives them entrance into the organism and circulation) to pathogenic strains which develop in the bird with a great power of growth and cause an infection the results of which are generally fatal.

The object of the author has been specially to draw the attention of breeders to a disease which is often unperceived and for which the right remedy has yet to be found.

The Use of Naphthalene as a Remedy for Chicken Lice. *W. S. Abbott, Jour. of Econ. Entom., Concord, U.S.A.*—The author has experimented with various preparations of naphthalene as a means of destroying chicken lice of the species *Menopon biseriatum*, *M. pallidum*, *Lipeurus heterographus* and *Goniocotes abdominalis*. The naphthalene used for dusting in the feathers, a powder containing 5 per cent. of naphthalene is ineffective, but a powder containing 10 per cent. is very effective; it causes, it is true, slight discomfort, but this is quite temporary and after 5 to 10 minutes the fowl no longer feels any ill effects.

By thoroughly rubbing powder containing 60 to 100 per cent. of naphthalene into the feathers there is risk of killing the fowls; on the other hand, powders of the same strength lightly dusted over the feathers cause no permanent injury.

A suitable method for reducing considerably the number of lice consists in sprinkling finely powdered naphthalene over the fowls when they are roosting at night, but this method requires further testing.

Balls of naphthalene placed in the nest had no effect in diminishing the number of lice on the hen setting or laying there, but they injured the hens and prevented them from setting well and seemed to have a toxic effect on the eggs and newly hatched chicks.

Eradication of the Depluming Mite of Chickens by One Treatment. *H. P. Wood, Jour. of Econ. Entom.*—The author has reported that the depluming mite of chickens (*Cnemidocoptes gallinæ*) can be completely eradicated by a single treatment of one of the following:—

Lime-sulphur bath: 1 lb. lime, 2 lbs of sulphur, 1 gallon of water; dilute the mixture in 20 parts of water.

Tobacco sulphur bath: 3 teaspoonfuls of "Black leaf 40" tobacco extract+6 ounces of sulphur+2½ gallons of water.

Arsenical bath as used for destroying ticks in cattle.

Sodium fluoride and sulphur bath: ¼ ounce of sodium fluoride+2 ounces sulphur+1 gallon of water.

Sodium fluoride, sulphur and soap bath: ¼ ounce of sodium fluoride+21 ounces sulphur+sufficient soap to make the water soapy+1 gallon of water. This bath destroys not only the depluming mite but also lice.

Kerosene emulsion is effective against the parasite but is injurious to the fowl treated.

OFFICIAL ORDERS AND CIRCULARS.

THE following Press notice was issued recently:—

Forms of claim for any payments that may prove to be due to growers of wheat and oats in 1921 under Part I. of the Corn Production Act, 1917,

Guaranteed Prices for Wheat and Oats.

as modified by Part I. of the Agriculture Act, 1920, will shortly be issued by the Board of Agriculture for Scotland. The forms will be distributed by the local officers of Customs and Excise to all occupiers of agricultural holdings exceeding one acre in extent, along with the schedules for the Annual Agricultural Returns. Crofters in certain parishes in Inverness-shire and Ross-shire, whose Agricultural Returns are made collectively, will receive copies of the form of claim direct from the Board. Any person growing one acre or more of wheat or oats

who has not received a form by the 15th of June should at once communicate with the Board.

No claim should be made in respect of either crop unless the area under that crop is one acre or more. The name (if any) of each field and the *net* acreage under the crop should be inserted where shown on the form; a separate place is provided for mixed crops. The claimant's signature should be witnessed.

Forms of claim must be returned to the Board of Agriculture for Scotland by 30th June. Claims received after 4th July will be treated as invalid unless it can be shown that they were posted not later than 30th June.¹

Attention is directed to the following points:—

- (1) The amounts that may prove to be payable are fixed by the method laid down in the Acts mentioned above. The "minimum price" for each crop will be fixed by three Commissioners, on the basis of the cost of production, and will bear the same proportion to 68s. per quarter of 504 lbs. (for wheat) and 46s. per quarter of 336 lbs. (for oats) as the cost of production in 1921 bears to the cost of production in 1919, which is the "standard year." The "market price" will be the average of the weekly prices returned under the Corn Returns Act for the period 1st September 1921 to 31st March 1922.
- (2) If the market price is greater than or equal to the minimum price in the case of either crop, no payment will be due. If the market price is less than the minimum price, the grower of wheat will be entitled to receive four times the difference per acre and the grower of oats five times the difference per acre. Thus if the minimum price of oats is fixed at 44s. and the market price is 36s. each grower will receive £2 per acre.
- (3) Payment may be withheld or modified in cases of negligent cultivation, as provided by Section 1 (b) of the Act of 1917.
- (4) Apart from this provision, the amount payable does not depend on the actual yield per acre. Nor is it affected by the price at which the farmer sells his grain. The farmer who produces six quarters per acre and sells at 40s. and the farmer who produces three and a half quarters and sells at 28s. will receive the same amount (if any) in respect of the guarantee. Nor does it matter whether the grain is sold or consumed on the farm.
- (5) The Agricultural Committees will in the course of the summer inspect a proportion of the farms in their areas, chosen fortuitously, in order to check the acreage.
- (6) After harvest, each claimant will be required to sign a declaration that the grain in respect of which his claim is made has actually been harvested.

The following notice was issued to the Press in May 1920:—

Inspection of Crops of Potatoes of the Immune Varieties.

Intimation has been received from the Board of Agriculture for Scotland that arrangements have been made by them for the inspection and certification of crops of potatoes of the immune varieties.

Forms of application may be obtained from the Secretary of the Board, and these should be filled up and returned not later than 30th June 1921.

As a general rule application should not be made for any crop unless it extends to $\frac{1}{4}$ acre or more, but special consideration will be given to growers who have small stocks of new or scarce varieties, or to nurserymen who grow small lots of different varieties for retailing directly to small growers.

The fee for inspection will be according to the following scale:—

Up to and including 2 acres 5s
Over 2 acres at the rate of 2s. per acre or part of an acre.

No application will be accepted unless it is accompanied by a remittance for the full amount of the fee payable.

¹ Period subsequently extended to 19th July and, in cases of change of tenancy, to 30th July.

The following notice was issued to the Press in April :—

Importation of Gooseberries.

The Board of Agriculture for Scotland announce that they have issued a general licence under the American Gooseberry Mildew (Scotland) Order of 1920, authorising the importation of goose-

**American Gooseberry
Mildew.**

berries from abroad, provided they are accompanied by a certificate of freedom from American Gooseberry Mildew issued by a duly authorised official of the country of origin. Importers of gooseberries will not, therefore, require to obtain individual licences from the Board during the coming season, but they should make certain, when purchasing gooseberries from abroad, that the required certificate of freedom from disease will be forwarded along with any gooseberries consigned to them. If any consignment arrives at a Scottish port without an official certificate as to its freedom from American Gooseberry Mildew, its landing in this country will not be allowed by the Customs Authorities.

The following is the text of the Board's scheme for the improvement of sheep in the counties of Argyll, Inverness, Ross and Cromarty, Sutherland, Caithness, Orkney and Shetland

The Board of Agriculture for Scotland are prepared to receive applications from Crofters Common Grazings, or other
Scheme for the Improve- duly constituted Committees, for assistance in the
ment of Sheep. provision of a limited number of rams for service during season 1921 on the terms noted below.

In all cases of applications from townships where there are common grazings it is necessary that the Committees should be appointed in accordance with the terms of the Crofters Common Grazings Acts, and that the rules of the Committees be approved by the Land Court. In cases of applications from townships where no common grazings exist the Committees should be duly constituted bodies representative of the people of the district. In no case can an application from an individual be considered

I. HIRE OF RAMS, THE PROPERTY OF THE BOARD, TO COMMITTEES

The Board will hire out rams of the Cheviot and Blackfaced breeds to Committees on the following terms :—

- (1) The fee payable by the Committees shall be £1 for each ram hired, and must be remitted to the Board along with the forms of application
- (2) The Committees shall be responsible to the Board for the proper care of the rams while in their custody.
- (3) The Committees shall arrange for taking delivery of the rams at the nearest or most convenient railway station or steamer pier to their township or village, and at the end of the season the rams must be collected and put on rail or steamer, as the case may be, at the expense of the Committees
- (4) While the Board will take all possible care to supply suitable rams, they will not be responsible for any failure or unsatisfactory result.
- (5) All the rams supplied by the Board are inspected and certified to be free of disease by a veterinary surgeon before being dispatched to Committees, and the Board will therefore accept no liability for the consequences following on any outbreak of disease that may occur after delivery of the rams has been taken by the Committees.

II. HIRE OF RAMS BY COMMITTEES FROM FARMERS.

The Board will also consider applications from Committees for grants towards the cost of hiring rams of the Cheviot, Border Leicester or Blackfaced breeds from neighbouring farmers on the following terms :—

- (1) The rams must be subject to the approval of the Board.
- (2) The Board's grant in respect of such rams will in no case exceed the sum of 35s. per ram, and the Committee's contribution towards the

cost of the hire of each ram must be at least £1, which fee must be remitted to the Board along with the forms of application.

- (3) Full particulars of the arrangements made, giving cost of hire, etc., between the Committees and the owners of the rams should be communicated to the Board along with the applications.

NOTE.—In order to allow farmers from whom rams are to be hired to make the necessary arrangements to have suitable animals available, it is essential that negotiations should be entered into without delay.

III. SALE OF RAMS BY THE BOARD TO COMMITTEES AT HALF OF THE COST PRICE.

The Board are willing to sell a limited number of Border Leicester rams to Committees in the counties of Caithness and Orkney, and to Committees of new Settlements created with the assistance of the Board, at half of the cost price of the rams. These rams will be delivered free of charge to the Committees at the nearest or most convenient railway station or steamer pier to their township or village. The half cost of the rams must be remitted to the Board not later than 1st January 1922.

All applications for assistance under any of the heads of this scheme must be made on the prescribed form (Ag. 49), which may be obtained from the Secretary to the Board, and such applications must be lodged with the Board not later than 30th June 1921. The Board cannot undertake to consider applications received after that date.

The following is the text of the Board's scheme for Assisting Local Agricultural Shows in 1921 :—

I. NATURE AND CONDITIONS OF ASSISTANCE.

Scheme for Assisting Agricultural Shows. 1. The Board of Agriculture for Scotland are prepared to assist (a) Crofters' Shows and (b) Agricultural Shows in the Congested Districts of Scotland at which there are classes confined to Small Farmers' Stock.

NOTE.—For the purposes of this scheme the term " Small Farmer " includes all occupiers of land the annual rent or value of which, as entered in the Valuation Roll, does not exceed £100, or, if this be more than £100, the area of which does not exceed 100 acres and who derive their living mainly, if not altogether, from their holdings.

2. The assistance will take the form of grants towards the provision of (a) Prizes and (b) Equipment (Fencing, Flakes, Coops, etc.). In no case, however, can a grant under (a) exceed £30 and under (b) exceed £20. Grants towards equipment will be made only when the Board are satisfied that such assistance is necessary for the continuation of a Show, or to enable a new Show to be held.

3. In every case in which assistance is given the Shows must be managed by a representative Local Committee.

II. APPLICATIONS FOR GRANTS.

4. Applications for grants in respect of Shows to be held during 1921 must be received by the Board not later than the 31st day of May.

5. All applications for grants must be accompanied by :

- (a) A copy of the proposed Premium List or Schedule of Prizes ;
- (b) A balance sheet, setting forth in detail the receipts and expenditure of the Committee during the year in which the Show was last held.
- (c) In the case of new Shows, a statement of the amount of local financial support (subscriptions, entry money, gate money, etc.) that may reasonably be expected.
- (d) A statement of the area which the Show serves or will serve ;
- (e) A note of the date, or alternative dates, proposed for the holding of the Show.

6. Each application for assistance from the Board will be considered on its merits, and in coming to a decision regard will be had to :

- (a) The distance between the various centres from which applications have been received, and
- (b) Local circumstances and conditions generally.

7. Any grant that may be made by the Board will apply only to the current year, and is not to be considered an *annual* grant.

III. CONDITIONS GOVERNING AWARD OF PRIZES FOR LIVE STOCK.

8. While not wishing to interfere unduly with the discretion of local committees, the Board desire it to be kept in view that the main object of Crofters' Shows—or Small Farmers' Classes at Agricultural Shows—is (so far as live stock is concerned) the improvement of the stock kept and used on Crofts and Small Holdings. To this end the Board consider that all breeding stock exhibited should :

- (a) In the case of females, be bred by the exhibitor ;
- (b) In the case of males, either be bred by the exhibitor, or, if bought, be retained by him for at least twelve months after the prize has been awarded.

9. Before paying the prizes in classes for Rams, Bulls or Stallions, the Secretary should be assured that the prize animals :

- (a) Were used in the Show district the previous season, or
- (b) Will be used in the district during the succeeding season.

IV. THE BOARD'S SPECIAL PRIZES.

10. In order to encourage Crofters to keep promising heifers or Highland pony or other fillies, the Board, in addition to any grant given under the foregoing clauses, will be prepared to give prizes of £2, £1 and 10s. :

- (a) For the best heifers in milk or in calf, the age for classification to be fixed by the Show Committee, subject to the approval of the Board ;
- (b) For the best 3-year-old Highland pony mares or other breed suitable for Small Farmers whether eild or in foal or with foal at foot.

SPECIAL APPLICATION must be made to the Board by the Show Committee for these prizes.

These special prizes will not be awarded unless the exhibitor undertakes to retain the prize animal in his possession for at least twelve months after the date of the Show. The prize money will not be paid over until after the production to the Board of satisfactory evidence that the prize animals have been (a) retained in the possession of the successful exhibitors for not less than twelve months after the date of the Show at which the prizes have been awarded ; (b) served by an approved sire during the period.

All applications for assistance should be addressed to the Secretary, Board of Agriculture for Scotland, 29 St Andrew Square, Edinburgh, and must be received not later than 31st May 1921.

In a Report on " Farm-Workers in Scotland in 1919-20," an account was given of the minimum rates in force in September 1920. Since then a

Minimum Wages

for Farm-workers.

number of changes have taken place and, as the Wages Committees originally constituted under Part II. of The Corn Production Act, 1917, completed their term of office on 31st March 1921, it will be convenient to give a summary of the minimum rates in force on that date for each of the twelve districts into which Scotland has been divided for the purpose. In Scotland, under the Second Schedule to the Act, minimum rates of wages are normally fixed by the Wages Committee for the district but may be disallowed by the Central Committee ; and if the Central Committee twice disallow a rate fixed by the District Committee, the

question of fixing the rate is referred by the Board of Agriculture to the Central Committee. Each District Committee had its own ideas as to the scheme of rates suitable to its area, and as the Central Committee generally proceeded on the principle of allowing the rates fixed by the District Committee to stand, whenever its decision was a practically unanimous one, the result has been that there is a considerable diversity in the rates fixed, and in the classifications adopted for the different districts. This summary is, for the most part, confined to the rates for male workers over the age of 18, and for female workers over the age of 17, though minimum rates have also been fixed for boys and girls.

Dumfries and Galloway District.

On 6th September 1920 the Dumfries and Galloway Committee fixed the following rates:—

Ploughmen, cattlemen and shepherds:—

Over 21 years of age	...	...	48s. per week.
From 18 to 21 years of age	...	...	43s. " "
Other male workers over 18 years of age.	...	...	42s. " "
Dairymaids capable of making butter and cheese	...	...	34s. " "
Women over 17 years of age (engaged for a term and boarded by employer)	...	...	31s. " "

These rates are to be increased by 2s. 6d. per week for the first dog, and an additional 2s. per week for each additional dog, which the workman is required by the conditions of his employment to keep and feed.

On 22nd November 1920 they fixed the following rates:—

Cotwomen (employed the whole year round)	...	28s. per week
Women (casual workers) over 17 years of age with at least one year's experience in agricultural work	...	6½d. per hour.
Women over the age of 17 years to whom no other rate applies	...	5½d. " "
Milkers with 18 months' experience, milking 10 cows night and morning from 1st March to 15th August, and milkers for the remainder of the period irrespective of the number of cows milked where not less than 10	...	10s. per week.
Milkers milking less than 10 cows	...	1s. per cow per week.

These rates are to be reckoned as applying to the following working hours:—

From 1st February to 15th June	...	9 hours per day.
From 16th June to 15th October	...	10 " " "
From 16th October to 31st January	...	8 " " "

—exclusive of meal-times and time required for stable work, and of 21 whole, or 42 half, holidays, none of which shall be demandable during 10 weeks of hay and harvest.

Border Counties District.

On 31st January 1921 the Border Counties Committee fixed the following rates to come into force on 1st March:—

Able-bodied skilled ploughman, cattleman and orraman of 18 years of age and over	...	47s. per week.
Shepherd of 18 years of age and over in charge of a hirsle of sheep	...	53s. " "
Other male agricultural workers of 18 years of age and over	...	42s. 6d. " "
Skilled female agricultural workers of 17 years of age and over	...	29s. 6d. " "
Other female agricultural workers of 17 years of age and over	...	27s. 6d. " "

A ploughman, cattleman or orraman is entitled to the higher rate when he has worked on a farm continuously for 3 years before or for 2 years after

having reached the age of 18. A female is to be regarded as skilled only in the event of her having attained the age of 17 and having worked on a farm continuously for one year.

The rates are fixed on the footing that the number of working hours is the number of hours customarily wrought in the district in which the workman is employed.

On 9th December 1920 the District Committee fixed the following minimum rates :—

Able-bodied forester of 18 years of age and over	42s. 3d. per week.
Able-bodied skilled nurserymen and market gardeners of 18 years of age and over ...	47s. „ „
Other male workers of 18 years of age and over employed in a nursery or market garden	42s. 3d. „ „
Skilled female workers in a nursery or market garden	28s. „ „
Other female workers of 17 years and over employed in a nursery or market garden ...	25s. „ „

A nurseryman or market gardener is to be regarded as skilled only in the event of his having worked in a nursery or market garden continuously for 3 years before or for 2 years after having reached the age of 18. A female worker is to be regarded as skilled only in the event of her having attained the age of 17, and having worked in a nursery or market garden continuously for one year. These rates are to be held to apply to the hours of employment customary in the district in which the worker is employed.

Lothians and Peebles District.

The question of fixing minimum rates for the Lothians and Peebles District having been referred by the Board of Agriculture to the Central Committee, that Committee on 17th August 1920 fixed the following rates, to take effect from that date :—

Ploughman, cattleman or shepherd over 21 who has had 2 years' experience of farm work	48s. per week or 12d. per hour.
Other male workers over 18 years	40s. per week or 10d. per hour.
Boy from 16 to 18 years	30s. per week or 8d. per hour.
Boy from 14 to 16 years	18s. per week or 4½d. per hour.
Boy under 14 years	12s. per week or 3d. per hour.
Woman over 18 who has had 12 months' experience of farm work	28s. per week or 7d. per hour.
Other women over 18 years	25s. per week or 6d. per hour.
Girl from 16 to 18 years	20s. per week or 5d. per hour.
Girl from 14 to 16 years	16s. per week or 4d. per hour.
Girl under 14 years	12s. per week or 3d. per hour.

These rates are to be increased by 2s. 6d. a week for each dog which the workman is required by the conditions of his employment to keep and feed.

No condition was prescribed as to the number of hours on which these minimum rates were to be reckoned.

Fife and Kinross District.

The question of fixing minimum rates payable to male workmen of 18 years of age and upwards in the Fife and Kinross District having been referred by the Board of Agriculture to the Central Committee, that Com-

mittee on 22nd February 1921 fixed the following minimum rates to take effect as from that date :—

The minimum rates hereby fixed shall be increased by 2s. 6d. a week for each dog which the workman is required by the conditions of his employment to keep and feed.

The minimum rates hereby fixed shall be reduced by 4s. per week, or 1d. per hour, during the first three years of a man's employment in farm work, forestry, nursery work or market gardening as the case may be.

The minimum rates hereby fixed shall, for a ploughman, cattleman or shepherd, be increased by 6s. per week, or 1½d. per hour, from the time during which he is under contract of employment or employed as such.

Subject to the above conditions the minimum rate for a male workman over 21 years of age shall be 42s. per week, or 10½d. per hour.

Subject to the above conditions the minimum rate for a male workman between 18 and 21 years of age shall be 39s. per week, or 10d. per hour.

The effect of this order may be summarised as follows :—

Ploughman, cattleman or shepherd over 21—

Experienced	...	...	...	{ 48s. per week or 12d. per hour.
Inexperienced	...	...	...	{ 44s. per week or 11d. per hour.

Ploughman, cattleman or shepherd between 18 and 21—

Experienced	...	...	...	{ 45s. per week or 11½d. per hour.
Inexperienced	...	...	...	{ 41s. per week or 10½d. per hour

Other male worker over 21—

Experienced	...	..	...	{ 42s. per week or 10½d. per hour.
Inexperienced	...	.	...	{ 38s. per week or 9½d. per hour.

Other male worker between 18 and 21—

Experienced	...	...	...	{ 39s. per week or 10d. per hour.
Inexperienced	...	...	...	{ 35s. per week or 9d. per hour.

No condition was prescribed as to the number of hours on which these minimum rates were to be reckoned.

On 22nd January 1921 the District Committee fixed for women, including girls over 16 years of age, 24s. per week, or 4s. per day of 8 hours at 6d per hour, to be reckoned as applying to a working week of 50 hours from 15th February to 30th November, and of 44½ hours from 1st December to 14th February.

Clyde and Forth District.

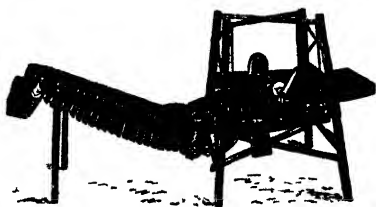
The question of fixing minimum rates for the Clyde and Forth District having been referred by the Board of Agriculture to the Central Committee, that Committee on 17th August 1920 fixed the same minimum rates for the Clyde and Forth District as those given above for the Lothians and Peebles District, except that (1) the rate for a ploughman, cattleman or shepherd over 21 years who has had 2 years' experience of farm work was fixed at 50s. per week, or 14d. per hour, and (2) the amount by which the minimum rates are to be increased for each dog was fixed at 3s. per week instead of 2s. 6d. These rates took effect from 17th August 1920.

No condition was prescribed as to the number of hours on which these minimum rates were to be reckoned.

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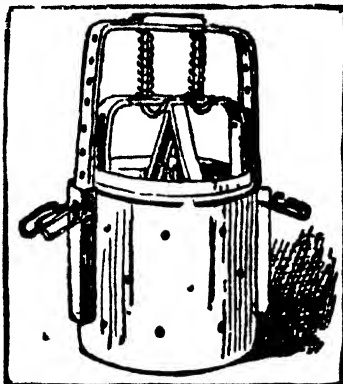
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Ayr District.

The question of fixing minimum rates of wages for male workers of 18 years and upwards in the Ayr District having been referred by the Board of Agriculture to the Central Committee, that Committee on 12th June 1919, in accordance with the unanimous wish of the District Committee, fixed a flat rate of 37s. per week, or 9d. per hour, for all male workman over 18 years of age, to be reckoned on the hours customarily worked in the district, with an addition of 2s. 6d. per week for each dog which the workman is required by the conditions of his employment to keep and feed. They also fixed the differential rate in the case of overtime at $1\frac{1}{2}$ times the rate fixed per hour.

On 22nd March 1921 the Central Committee issued a proposal to raise the minimum rate for a male workman over 18 years of age from 37s. per week, or 9d. per hour, to 42s. per week, or 10½d. per hour.

On 1st November 1918 the District Committee fixed a minimum rate of 4½d. per hour for women of 16 years and over.

South West Highlands District.

On 22nd January 1921 the District Committee for the South West Highlands District fixed the following minimum rates on the footing that the number of working hours is the number of hours customarily wrought in the district in which the workman is employed:—

Experienced shepherds, ploughmen and cattle-men of 21 years of age and over	43s.	per week.
Shepherds, ploughmen and cattlemen of 18, but under 21 years, with not less than 4 years' experience as such	40s. 6d.	" "
Shepherds, ploughmen and cattlemen of 18, but under 21 years, with less than 4 years' experience as such	38s.	" "
With, in addition, as regards shepherds, in the three classes above specified, 2s. 6d. per week for each dog necessarily kept by the shepherd for the employer's business (if such dog is not maintained by the employer).		
Males, other than those above specified, of 21 years of age and over	35s. 6d.	" "
Males other than those above specified, of 18, but under 21 years	34s. 6d.	" "
Byewomen and dairymaids wholly or mainly employed in agriculture, of 16 years of age and over	29s. 6d.	" "
Females other than those above specified, of 18 years of age and over	4s. 2d.	per day.
Girls of 16 years of age, but under 18 (other than byewomen and dairymaids)	21s. 3d.	per week

Forfar and Perth District.

On 12th February 1921 the District Committee fixed the following rates to take effect from 1st March:—

Ploughman, cattleman or shepherd over 21 years, with at least 2 years' experience in agriculture	47s. per week or 11½d. per hour.
Ploughman, cattleman or shepherd over 21 years, with less than 2 years' experience in agriculture	43s. 6d. per week or 10½d. per hour.
Other male workmen over 21 years (and being what are known as "orramen"), with at least 2 years' experience in agriculture	38s. 6d. per week or 9½d. per hour.
Other male workmen over 21 years (and being what are known as "orramen"), with less than 2 years' experience in agriculture	35s. per week or 8½d. per hour.

These rates are to be increased by 2s. 6d. a week for each dog which the workman is required by the conditions of his employment to keep and feed,

and are to be reckoned as applying to an average for the year of 54 hours per week exclusive of meal-times, and time required for stable work, allowance being made for 21 full days' or 42 half days' holidays in each year, besides (1) the usual New Year's Day Holiday, and (2), in the case of yearly engagements, one hiring fair day, and in the case of half-yearly engagements, two hiring fair days.

All employment in excess of the working hours so calculated is to be treated as overtime employment for the purposes of the differential rates for overtime, provided that when a workman is, by the conditions of his employment, required to attend to animals, no stable work, byre work, shepherding or other work necessary for the health and comfort of the animals shall be reckoned as overtime employment.

On 12th February 1921 the District Committee also fixed the following rates to take effect from 1st March :—

Men from 18 to 21 other than foresters, market gardeners or nurserymen	...	...	35s.	per week.
Foresters :—				
Men of 21 years and upwards	...	...	35s.	" "
Men between 18 and 21	...	...	30s.	" "
Market Gardeners :—				
Men of 21 and upwards	...	...	37s. 6d.	" "
Men between 18 and 21	...	...	35s.	" "
Women of 17 and upwards	...	...	5d.	per hour.
Nurserymen :—				
Men over 21	...	...	7½d.	" "
Men between 18 and 21	...	...	6½d.	" "
Women of 17 and upwards	...	...	5d.	" "

These rates are based on the understanding that the hours of work shall be those customarily observed in the district.

The District Committee had also fixed a rate of 4½d. per hour for women other than those employed in woods, market gardens or nurseries, but this rate was disallowed by the Central Committee as inadequate.

North Eastern Counties District.

On 5th October 1920 the District Committee for the North Eastern Counties fixed the following minimum rates :—

Male workmen above 20 years of age	...	45s.	per week.
Male workmen between 18 and 20 years of age	...	38s. 7d.	" "
Male workmen over 18 years of age employed in nurseries	...	40s.	" "
Women of 18 years and over	...	25s. 8d.	" "
and for broken time	...	5d.	per hour.

Moray Firth District.

On 29th October 1918 the following minimum rates were fixed by the Moray Firth Committee :—

Qualified ploughmen, cattlemen or shepherds of 21 years and over	...	36s.	per week.
Men over 18 and under 21 having 3 years' experience as ploughmen, cattlemen, or shepherds	...	36s.	" "
Other male workers over 18 years	...	30s.	" "
Women over 18 years	...	20s.	" "

An allowance of 2s. 6d. per week is to be paid for each dog necessarily kept by the shepherd for the employer's business when the dog is not fed by the employer.

These rates have been fixed on the basis that the working hours in each week shall be 60, inclusive of time for stable work.

On 21st January 1919 the District Committee fixed the following rates for workers employed in forests, market gardens and nurseries:—

Men over 18 with 3 years' experience	...	36s. per week.
Other men over 18	...	30s. " "
Women over 18	...	20s. " "

These rates also have been fixed on the basis that the working hours in each week shall be 60.

Since the above dates no change has been made in the minimum rates for this district.

North West Highlands District.

On 22nd January 1919 the North West Highlands Committee fixed the following minimum rates—

Men (a) married, or (b) widowed, and having a family to support; or (c) widowed, or of 21 years and single, who may prove to the satisfaction of the Committee that he has one or more relatives to support	...	32s. per week.
Man, single or widowed (without such family or relatives), of 21 years and over	...	27s. " "
Man, single or widowed, over 18 and under 21 years	...	25s. " "

These rates have been fixed on the basis of the customary hours of employment prevailing in the district.

On 12th June 1919 the Central Committee fixed for this district the minimum rate for a woman over 18 of 20s. per week, or 4½d. per hour.

On 9th February 1921 the District Committee fixed enhanced minimum rates, but they were disallowed by the Central Committee on the ground that they were too high and unsuitable for the district.

Northern Counties District.

Sutherland.—On 30th June 1920 the Northern Counties Committee fixed the following rates for the County of Sutherland:—

Male shepherds of 21 years and over in charge of a hirsell of sheep	...	46s. per week.
Experienced male shepherds between 18 and 21 years in charge of a hirsell of sheep	...	43s. " "
Experienced male workers, including ploughmen, cattlemen, byremen and orramen	...	45s. " "
Other male workers over 18 years	...	40s. " "
Women of 18 years and over	...	25s. " "

An experienced male worker shall be held to be one who has been employed in agriculture for two years.

These rates are to be increased by 2s. 6d. per week for each dog which the workman is required by the conditions of his employment to keep and feed. They have been fixed on the footing that the number of working hours is the number of hours customarily worked in the district in which the workman is employed.

Caithness.—On 30th June 1920 the Northern Counties Committee fixed the following minimum rates for the County of Caithness:—

Male workers of 21 years and over having not less than 2 years' experience of work in agriculture	...	41s. per week.
Males between 18 and 21 years having not less than 2 years' experience of work in agriculture	...	35s. " "
Other males of 21 years and over	...	35s. " "
Other males between 18 and 21	...	31s. " "
Females over 18 years	...	23s. " "
Females over 18 years (who are casually employed)	...	5d. per hour.

These rates are to be increased by 2s. 6d. per week for each dog which the workman is required by the conditions of his employment to keep and feed. They have been fixed on the footing that the number of working hours is the number of hours customarily worked in the district in which the workman is employed.

Orkney.—On 26th October 1920 the Northern Counties Committee fixed the following minimum rates for the County of Orkney :—

Male workers of 21 years and over	...	...	41s. per week.
Male workers between 18 and 21 years	...	...	36s. " "
Female workers over 18 years	...	...	24s. " "
Female workers over 18 years (who are casually employed)	...	...	4s. per day.

Shetland.—On 4th August 1920 the Northern Counties Committee fixed the following minimum rates for the County of Shetland :—

Male workers over 21 years	...	...	{ 46s. per week or 10d. per hour
Male workers between 18 and 21 years	...	...	{ 37s. per week or 8d. per hour.
Women of 18 years and over	...	...	{ 30s. per week or 7d. per hour

These rates are to be increased by 3s. per week for each dog which the workman is required by the conditions of his employment to keep and feed. They have been fixed on the footing that the number of working hours is the number of hours customarily worked in the district in which the workman is employed.

The appended Statement puts together some of the more important minimum rates in force in the different districts.

MINIMUM RATES PER WEEK IN FORCE ON 31ST MARCH 1921.

Note.—The term "Orroman" here includes all male workers who are neither Ploughmen, Cattlemen nor Shepherds.

District.	Man over 21.				Lad of 18.				Ordinary Woman Worker.	
	Inexperienced Ploughman.		Experienced Orroman.		Inexperienced Ploughman.		Experienced Orroman.		Experienced.	Inexperienced.
	s. d. per week.	s. d. per week.	s. d. per week.	s. d. per week.	s. d. per week.	s. d. per week.	s. d. per week.	s. d. per week.		
Dumfries and Galloway...	48 0	48 0	42 0	42 0	43 0	42 0	42 0	42 0	s. d. per hour. 0 5½	s. d. per hour. 0 5½
Border Counties...	47 0	42 6	47 0	42 6	47 0	42 6	47 0	42 6	per week. 27 6	per week. 27 6
Lothians and Peebles ...	48 0	40 0	40 0	40 0	40 0	40 0	40 0	40 0	25 0	25 0
Fife and Kinross ...	48 0	44 0	42 0	38 0	45 0	39 0	35 0	35 0	24 0	24 0
Clyde and Forth ...	50 0	40 0	40 0	40 0	40 0	40 0	40 0	40 0	25 0	25 0
Ayr ...	37 0	37 0	37 0	37 0	37 0	37 0	37 0	37 0	per hour. 0 4½	per hour. 0 4½
South West Highlands...	43 0	35 6	35 6	35 6	40 6	34 6	34 6	34 6	per day. 4 2	per day. 4 2
Forfar and Perth ...	47 0	43 6	38 6	35 0	35 0	35 0	35 0	35 0	per hour. 0 4	per hour. 0 4
North Eastern Counties .	45 0	45 0	45 0	45 0	38 7	38 7	38 7	38 7	per week. 25 8	per week. 25 8
Moray Firth ...	36 0	30 0	30 0	30 0	36 0	30 0	30 0	30 0	20 0	20 0
North West Highlands ..	32 0	27 0	32 0	27 0	32 0	32 0	25 0	25 0	20 0	20 0
Northern Counties :—	(married)	(single)	(married)	(single)	(married)	(single)	(married)	(single)		
Sutherland ...	45 0	40 0	45 0	40 0	45 0	40 0	45 0	40 0	25 0	25 0
Caithness ...	41 0	35 0	41 0	35 0	35 0	31 0	35 0	31 0	23 0	23 0
Orkney ...	41 0	41 0	41 0	41 0	36 0	36 0	36 0	36 0	24 0	24 0
Shetland ...	46 0	46 0	46 0	46 0	37 0	37 0	37 0	37 0	30 0	30 0

STATISTICS.

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS
in March, April and May 1921.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	MARCH.			APRIL.			MAY.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:--									
CATTLE—	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.	per cwt. s. d.
Aberdeen-Angus ...	113 4	105 10	78 10	112 6	104 11	80 2	100 8	93 5	73 0
Shorthorn ...	109 7	103 5	78 7	110 2	103 8	79 0	96 9	91 9	74 9
Galloway ...	108 11	101 0	94 0	111 5	104 3	94 3	102 0	93 0	...
Ayrshire ...	96 0	82 0	60 0	100 9	91 3	81 3	93 0	83 9	70 0
Cross-bred ...	108 10	100 10	80 7	109 3	101 3	82 1	97 6	90 6	73 0
Blue Grey ...	111 5	104 7	94 0	111 6	103 8	94 0	...	...	...
Highland ...	102 0	97 0	...	...	94 6	...	...	...	...
VEAL CALVES ...	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
	19½	13	9	19½	12½	9½	19½	12½	9
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot ...	25	23½	20	23½	22	19½	22½	21	18½
Half-bred ...	24½	23½	19½	24	22½	19½	22½	21½	18½
Blackface ...	22½	21	18½	22	20	18½	21	19½	17½
Greyface ...	25	23½	17½	23½	22½	17½	22½	21	17½
Down Crosses ...	25	23½	20	24	22½	...	22½	21½	...
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs ...	22 5	20 4	17 0	22 9	20 9	17 0	22 3	20 3	16 6
Porkers ...	22 8	20 10	17 0	23 2	21 9	17 0	22 7	21 1	16 6

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	MARCH.			APRIL.			MAY.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
STORE STOCK:—									
STORE CATTLE—									
Aberdeen-Angus :	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.
Yearlings ...	£ s. 33 9	£ s. 26 11	£ s. 18 7	£ s. 35 18	£ s. 28 9	£ s. 21 0	£ s. 32 18	£ s. 25 11	£ s. 20 4
Two-year-olds ...	45 9	36 2	29 5	49 6	39 16	32 5	45 1	37 7	29 3
Shorthorn :									
Yearlings ...	...	...	...	...	...	...	...	...	...
Two-year-olds ...	...	...	...	...	...	...	...	...	...
Galloway :									
Yearlings ...	27 0	22 7	17 0	30 0	23 10	19 0	35 0	26 0	20 0
Two-year-olds ...	...	37 3	20 17	...	38 5	30 7	52 0	45 0	36 7
Ayrshire :									
Yearlings ...	17 0	13 0	...	...	18 0	14 0	21 5	16 10	13 0
Two-year-olds ...	...	...	...	30 0	26 0	20 0	45 17	26 15	20 0
Cross-bred :									
Yearlings ...	27 15	22 10	16 17	32 0	25 12	19 2	30 0	24 4	18 19
Two-year-olds ...	45 10	35 8	27 3	47 12	38 17	30 14	44 6	36 11	31 16
Blue Grey :									
Yearlings ...	...	...	...	30 10	25 0	20 0	34 13	26 5	20 5
Two-year-olds ...	...	36 0	30 0	...	...	...	50 15	46 0	38 10
Highland :									
Yearlings ...	...	...	...	...	...	...	16 8	13 8	10 10
Two-year-olds ...	...	...	...	...	...	...	31 5	26 5	22 18
Three-year-olds ...	...	...	...	...	...	...	44 5	38 0	32 0
DAIRY COWS—									
Ayrshire :									
In Milk ...	57 10	40 4	22 17	52 9	37 8	23 7	50 0	37 13	24 16
Calvers ...	54 8	41 1	25 15	52 10	40 7	24 18	54 4	38 11	26 12
Shorthorn Crosses :									
In Milk ...	67 15	54 18	36 15	64 18	54 13	36 12	68 0	54 10	37 2
Calvers ...	57 14	42 18	29 2	56 11	42 9	29 4	56 11	41 15	28 3
STORE SHEEP—									
Cheviot Hogs ...	93 5	73 8	53 8	92 2	74 11	60 0	90 2	78 5	55 1
Half-bred Hogs ...	130 8	103 6	86 7	120 6	102 11	88 8	111 2	92 9	80 8
Blackface Hogs ...	59 4	55 10	36 3	62 11	50 8	42 1	59 9	48 10	40 2
Greyface Hogs ...	90 11	76 0	58 5	94 1	80 8	63 8	91 5	78 10	65 1
STORE PIGS—									
(6 to 10 weeks old)	88 4	64 1	...	95 2	72 9	...	94 8	74 4	...

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH,
AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	March.			April.			May.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF :—		per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.
Home-fed—		d.	d.	d.	d.	d.	d.	d.	d.	d.
Bullock or Heifer ...	1	17½	18	18½	17½	18½	18½	16	17½	17
	2	17	16½	18½	16½	17½	17½	15	16	16½
Bull	1	16	17½	16½	15½	17½	16½	14	16½	14½
	2	15	16½	15½	14½	16½	15½	12½	15½	12½
Cow	1	14½	14½	15½	14	14½	15½	12½	12½	14½
	2	12½	12½	14½	11½	12½	13½	10½	10½	12½
Irish—										
Bullock or Heifer ...	1	...	...	18	...	...	18	...	...	...
	2	...	...	17½	...	...	17½	...	...	...
Bull	1	...	...	15½	...	...	15½	...	...	...
	2	...	...	14½	...	...	14½	...	...	...
United States—										
Killed at Glasgow ...	1	...	...	18	...	...	18½	...	...	16½
	2	...	...	17½	...	...	17½	...	...	15½
Argentine Frozen—										
Hind Quarters ...	1	12	12	11½	11½	10½	11½	10½	9½	...
Fore " ...	1	8	8	7½	7½	7	7½	6½	5½	...
Argentine Chilled—										
Hind Quarters ...	1	...	...	11½	...	...	11	...	...	10½
Fore " ...	1	...	...	7½	...	...	6½	...	...	5½
Australian Frozen—										
Hind Quarters ...	...	...	...	...	...	...	...	...	...	...
Fore " ...	...	...	...	...	...	...	...	...	...	...
Monte Video Frozen—										
Hind Quarters ...	1	...	...	...	...	...	...	...	...	7½
Fore " ...	1	...	...	7	...	...	6½	...	...	4½
New Zealand Frozen—										
Hind Quarters ...	1	12	...	...	...	...	...	...	...	...
Fore	1	8	...	...	...	...	...	...	...	...
MUTTON :—										
Hoggs, Blackface ...	under 60 lb. and over.	23½	21½	23½	22½	21	22½	21½	20½	21½
		22½	21	22½	21½	19½	21½	20½	19½	20½
" Cross	60 lb. 60 lb. and over.	23½	22½	23½	22½	21½	22½	21½	21½	21½
		22½	21½	22½	21½	20½	21½	20½	19½	20½
Ewes, Cheviot ...	1	20½	18½	20	20½	19	19½	19½	19½	19½
	2	19	...	19½	19	...	19½	18½	...	19½
" Blackface ...	1	20½	16½	...	20½	...	19½	19½	...	19½
	2	19	...	19½	19	...	18½	18½	...	19½
" Cross	1	19½	17½	19½	19½	17½	19½	18½	18	19½
	2	18½	...	19	18	...	18½	17½	...	18½
Argentine Frozen	1	...	9	9	...	8½	...	...	9½	...
	2	...	...	7	...	8	...	...	8½	...
Australian "	1	...	9	...	...	8	...	...	...	...
	2	...	6	...	...	6	...	...	...	...
New Zealand "	1	8½	9	9	8½	...	8½	8½	...	8½
	2	8	6	7½	7½	...	7½	7½	...	7½
LAMB :—										
Home-fed	1	...	...	...	...	...	...	...	24	...
New Zealand Frozen...	1	14	13	9	14	13	...	14½	12½	13
	2	...	...	8	...	...	...	...	...	...
Argentine "	1	...	13	...	...	13	13	...	12	...

AVERAGE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporter.)

Description.	Quality.	March.		April.		May.		Description.	Quality.	March.		April.		May.	
		s.	d.	s.	d.	s.	d.			s.	d.	s.	d.	s.	d.
BUTTER :								BACON (continued) :							
Irish Creamery ... per cwt.	1	274	0	270	6	197	6	American, Long Clear	1	195	0	...	...	...	...
" (Unsalted) "	1	...	...	275	0	200	9	Middles (Green) ...	1	...	...	...	...	...	...
Canadian "	1	298	8	...	...	...	...	American, Short Clear	1	195	0	...	...	...	...
" (Unsalted) "	1	298	8	...	...	...	...	Backs ...	1	195	0	...	...	...	...
Danish ...	1	284	4	274	3	207	6	American, Bellies ...	1	195	0	...	...	...	...
" (Unsalted) "	1	284	4	274	3	210	6	American Sides ...	1	135	6	...	...	...	...
Australian ...	1	298	8	249	0	198	6	" Cumberland Cut	2	151	4	128	9	122	6
" (Unsalted) "	1	298	8	249	0	198	6	Canadian, Sides ...	2	169	0	95	0	90	0
New Zealand ...	1	298	8	266	5	204	3	Danish, Sides ...	2	...	...	130	0	92	6
" (Unsalted) "	1	298	8	266	5	205	6	HAMS :	2	...	...	100	0	143	9
Argentine ...	1	298	8	242	3	185	0	Irish (Smoked) ...	1	213	0	160	0	120	6
" (Unsalted) "	1	298	8	242	3	183	9	American, Long Cut	1	267	0	143	0	187	3
CHEESE :								(Green) ...	1	179	5	...	...	300	0
Cheddar ...	1	164	10	142	6	132	6	American, Short Cut	1	175	0	144	6	131	0
" (Unsalted) "	2	...	...	136	0	128	6	Canadian, Long Cut	1	179	5	...	...	132	9
Cheddar Loaf ...	1	...	...	151	6	145	0	EGGS :	1	...	...	...	...	...	...
" (Unsalted) "	2	...	...	...	...	...	...	Country ... per doz.	1	2	8	2	3	2	2
Dunlop ...	1	153	7	140	0	129	6	Irish ... per 120	2	2	6	2	1	2	0
" (Unsalted) "	2	...	...	136	0	123	0	" (Duck) ...	2	22	7	20	8	19	5
Canadian ...	1	159	4	...	...	117	6	Chinese ...	1	33	5	22	8	22	6
New Zealand ...	1	159	7	160	0	154	0	" (Duck) ...	2	30	3	21	5	22	0
" (White) "	2	154	0	154	0	...	...	Danish (Fresh) ...	1	17	0	16	0	...	...
" (White) "	1	...	...	144	0	140	0	" (Duck) ...	2	23	6	22	6	20	9
BACON :								Dutch (Duck) ...	2	22	3	21	2	19	5
Ayrshire (Rolled) ...	1	262	5	261	0	256	0	Egyptian ...	1	27	2	...	...	...	...
Irish (Green) ...	1	222	0	223	9	201	3			...	...	12	6	12	3
" (Dried or Smoked) "	1	237	7	240	0	220	6								
" (Long Clear) ...	1	237	0	238	9	233	9								
Wiltshire (Green) ...	1	222	0	223	9	202	6								
" (Dried or Smoked) "	1	237	7	239	0	218	9								

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH,
AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

			MARCH.					
MARKETS.	Quality.		Second Earlies.	LATE VARIETIES.				
				Red Soils.		Other Soils.		
				Lang- worthy.	Other.	Lang- worthy.	Other.	
				per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	per ton. £ s. d.	
Dundee	..	First	..	..	..	..	4 4 0	
		Second	..	..	..	..	3 15 0	
Edinburgh	...	First	..	10 0 0	..	..	5 2 2	
		Second	..	..	..	..	..
Glasgow	..	First	..	..	..	..	5 16 0	
		Second	..	..	..	..	..
APRIL.								
Dundee	..	First	..	..	..	..	4 6 3	
		Second	..	..	..	..	3 17 6	
Edinburgh	...	First	..	13 10 0	..	..	5 5 9	
		Second	..	..	..	..	..
Glasgow	...	First	..	..	..	..	6 0 0	
		Second	..	..	..	..	..
MAY.								
Dundee	..	First	..	..	..	..	5 0 0	
		Second	..	..	..	..	4 13 9	
Edinburgh	...	First	..	13 0 0	..	..	5 16 3	
		Second	..	..	..	..	..
Glasgow	...	First	..	..	..	..	6 5 0	
		Second	..	..	..	..	..

1921]

PRICES OF AGRICULTURAL PRODUCE.

AVERAGE PRICES OF ROOTS, HAY, STRAW, AND MOSS LITTER,
AT DUNDEE, EDINBURGH, AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

MARCH.											
Markets.	Quality.	Roots.			Hay.			Straw.			Moss Litter.
		Carrots.	Yellow Turnips.	Swedes.	Rye Grass and Clover.	Timothy.	Wheat.	Barley.	Oat.		
		per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton. s. d.
Dundee ...	1	...	17 0	20 8	150 0*	...	104 0*	110 0*	132 0*	69 0	...
	2	...	15 0	16 9	132 0*	...	...	...	...	...	...
Edinburgh	1	...	...	...	130 0†	...	78 9†	80 0†	78 0†	...	...
	2	...	...	...	81 3†	...	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	51 0	...
	2	...	...	...	...	...	...	...	...	...	...
APRIL.											
Dundee ...	1	...	...	20 3	141 3*	...	73 9*	...	85 0*	61 3	...
	2	...	...	18 0	120 0*	...	70 0*	...	80 0*	...	...
Edinburgh	1	...	...	...	109 5†	...	67 6†	...	65 0†	...	...
	2	...	...	...	70 0†	...	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	50 0	...
	2	...	...	...	...	...	...	...	...	...	...
MAY.											
Dundee ...	1	...	...	37 3	136 3*	...	70 0*	70 0*	70 0*	60 0	...
	2	...	...	30 8	120 0*	...	60 0*	60 0*	60 0*	...	...
Edinburgh	1	...	...	...	101 10†	...	60 0†	...	57 6†	...	...
	2	...	...	...	60 7†	...	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	50 0	...
	2	...	...	...	...	...	...	...	...	...	...

* Price for Hay and Straw baled and delivered.

† Price for Hay and Straw delivered loose in town.

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	MARCH.		APRIL.		MAY.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Linseed Cake	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Home ...	18 0 0	18 14 0	19 5 0	19 0 0	15 18 4	15 12 6
Foreign ...	17 10 0	...	...	...	13 15 0	...
Decorticated Cotton						
Cake ...	19 0 0	...	18 13 4	...	...	...
Undecorticated						
Cotton Cake						
Bombay						
(Home-						
manufactured)	10 19 0	10 6 3	11 0 0	10 7 6	11 13 9	10 13 9
Egyptian						
(Home-						
manufactured)	11 18 0	10 17 6	14 0 0	10 17 6	13 13 9	...
Palmnut Kernel						
Cake ...	...	...	...	9 0 0	9 5 0	9 0 0
Groundnut Cake ...	13 10 0	...	13 6 3	...	13 0 0	...
Germ Cake ...	17 16 8	...	16 17 6	...	16 10 0	...
Bean Meal...	15 6 0	...	13 16 8	14 15 0	13 10 0	15 10 0
Locust Bean Meal	14 4 0	12 10 0	14 0 0	12 10 0	14 5 0	12 10 0
Paisley Meal	11 7 6	...	...	...	...	...
Maize ...	11 15 0	13 0 0	10 6 3	12 10 0	10 10 0	12 0 0
Maize Meal	14 6 0	14 0 0	13 0 0	13 15 0	12 10 0	13 10 0
Maize Germ Meal	9 0 0	...	9 0 0	...	...	...
Maize Gluten Feed	...	...	...	...	...	...
Rice Meal ...	8 12 0	...	7 12 6	...	7 10 0	...
Oats ...	10 14 0	10 0 0	11 15 0	11 10 0	11 0 0	12 0 0
Barley (Feeding)...	10 4 0	10 0 0	11 0 0	11 0 0	10 11 3	11 0 0
Malt Culms	5 0 0	6 7 0	4 17 6	5 10 0	5 0 0	5 0 0
Distillery Mixed						
Grains						
Dried ...	8 16 0	9 13 0	8 1 3	8 10 0	7 6 3	8 5 0
Wet ...	...	...	...	...	...	...
Brewers' Grains						
Dried ...	8 0 0	7 10 0	7 11 3	7 7 6	7 2 6	6 12 6
Wet ...	...	...	...	...	...	...
Wheat—						
*Middlings (Fine						
Thirds or Parings)	9 2 0	9 10 0	11 12 6	9 0 0	9 10 0	8 15 0
Sharps (Common						
Thirds)...	8 14 0	...	9 10 0	...	8 8 9	...
Bran (Medium) ...	8 14 0	9 2 0	10 11 3	9 10 0	8 17 6	8 15 0
*Bran (Broad)	...	...	...	...	...	...
†Feeding Treacle ...	14 0 0	12 10 0	...	12 10 0	...	12 10 0
Crushed Linseed ...	...	...	...	23 0 0	...	23 0 0
Fish Meal ...	19 12 0	20 10 0	18 13 4	20 2 6	18 6 8	19 5 0

* Price of sacks included.

† Nett weight, barrels free.

* Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE

By DANIEL MACFARLANE & CO., LTD., 8 CHAMBERS STREET, EDINBURGH.

(2805) 11676/324. 3000. 7/21.—D.M.&Co.Ltd. (E)

The Scottish Journal of Agriculture

VOL. IV.—NO. 4.]

OCTOBER 1921.

PRICE 1s. NET.

SIMPLICITY AND ECONOMY IN THE TRANSFER OF LAND

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Introductory.—Land in Scotland has never been, and never will be, transferred as simply, as quickly, or as cheaply as other marketable commodities. While that may be from its nature inevitable, why should it not pass from seller to purchaser by a process analogous to the transfer of shares in a ship, or holdings in a Joint Stock Company? Such a question has been addressed many times to every practising lawyer. It may be by an inquiring friend, or by an indignant client protesting against the extravagant expense of acquiring a heritable property, as compared with a bull calf, or an automobile.

That the day will come when traffic in Scottish land will be as free from legal formality as share-broking is, I think, a vain hope, even although the present system of land tenure were to be scrapped, and the newest and most modern colonial method established in its place.

Complicating Incidents of Land Ownership.—Land ownership, not only here but in almost every country of the world, has been associated with the development of industry on the one hand, and the evolution of family life on the other, so essentially and beneficially that no well-balanced reformer will suggest the desirability of a change which sacrifices these features. In saying this I have chiefly in mind three incidents of ownership: first the power of the owner to burden land with debt, whether in the form of perpetual charges—e.g. feu duties and ground annuals, or ordinary redeemable debt; second, the power to affect land with family provisions, including generally the power to settle land; and third, the power to burden land with restrictive conditions and servitudes.

For the moment I reserve what I have to say as to the desirability or otherwise of perpetual money charges on land: The power to borrow money on the security of heritage by way of Bond and Disposition in Security, or a modification thereof, is wholly different. Lord Dunedin, speaking for himself and other members of the Royal Commission on Registration of Title in Scotland, said emphatically: "To take away this power would be simply to remove an enormous fund of national credit, and no one, we venture to think, would ever make such a proposal."

That it should be permissible for the owner of land to settle its destination through future generations by a strict entail is of more doubtful expediency. The right to do so has been greatly modified by a series of Statutes beginning in 1848, and there are many who believe that the time has come for the final abolition of entails. On the other hand, there are few who fail to recognise the propriety of permitting an owner to charge his heritage with family provisions, by the creation of liferent interests or otherwise, and that without the need of interposing an expensive trust.

It is obvious also that mere contiguity of estates, great or small, involves the existence of servitude and other rights prestable against each other by coterminous proprietors—rights of way, water rights, etc. That there should be clear written evidence either in the title of the owner whose land is so burdened, or in that of the owner who enjoys the right, or in both, does not require argument. Moreover, it has been the practice for many centuries for landowners to grant feus under conditions intended to affect the use of the land for all time, provisions, for example, as to the roads to be constructed and the buildings to be erected thereon, and generally restrictions as to the use to which the land is to be put—all these in the alleged interest of rural and urban amenity. Some, with whom I associate myself, think that the usefulness of such restrictive covenants has been greatly exaggerated, and that the time has come for the reconsideration on broader lines of the whole question of amenity. It cannot be denied, however, that restrictive conditions must remain to a modified extent, and must when they exist appear *ex facie* of the owner's title. Now all these incidents of land ownership are to a greater or less degree essential and permanent; they inevitably complicate, or at least elaborate, titles; and of themselves they seem to me to destroy the hope that land may, in the future, be transferred on the analogy of ship or company shares.

Cumbrousness of Present System.—But I certainly do not mean that further progress towards simplicity and economy is impossible. On the contrary, I believe that our system of land tenure, while possessing the virtue of great security and elasticity, and while it is not unduly complicated from the point of view of practitioners, remains both cumbrous and costly. Worse than all, from a democratic point of view, it is not understood of the people. It has, like a medical prescription, to be taken in faith. For this, it is usual to blame first and always the malign selfishness of the legal profession. Commercial men, among whom are included both the landlord and the farmer, have assumed an attitude of aloofness, almost of contemptuousness, as if existing systems of tenure and transfer were just evils to be accepted and borne without sense of responsibility. That attitude will not do. Laymen cannot wash their hands and pose as martyrs. It has often been said that a man marries the wife, a church calls the minister and a nation elects the government which they respectively deserve. And so, in a measure, a community enjoys the system of land tenure and transfer of which it is worthy.

At the outset it should be noted that while these incidents of land ownership to which I have referred must in some degree continue to complicate the conveying of land, the barrier to radical reform is older and lies deeper; it is to be discerned in the mists of antiquity. The truth is that nearly all the cumbrousness and costliness which still clog the tenure of land are traceable to its feudalistic origin; and the timorousness, which has been the characteristic of every statutory step towards simplicity, has been due to an unwillingness to break with feudalism once and for all. While feudal principles have been greatly modified to meet the requirements of later-day commerce, feudalism is still the mould which shapes the system. Till the mould is finally discarded there can, I fear, be no far-reaching reform.

No conscientious reformer cares for leaps in the dark. Before abandoning an existing system of land tenure and transfer, or even proceeding to modify it, he wants to be certain that he is not surrendering any essential—security, simplicity, expedition, economy. Laymen of the highest culture, but without technical knowledge, cannot effectively appeal for reform. They are profoundly impressed with the need for these essentials, and are hindered by a sense of insufficient equipment for attack. They are unable to demand specific reforms, because they cannot test them in relation to the essentials. In their appeal they are too suggestive of the crying for the light in the night, and with no language but a cry. Because I believe that radical reform is possible with due regard to all the essentials, and because I desire to strengthen the hands of those interested in land, I attempt, at the risk of boring my readers, a popular restatement of the present system of land tenure before I indicate the lines on which I think reform should proceed.

Historical Survey of Present System.—The basic fact of feudalism in relation to land tenure was the sovereign's ownership of practically all land. There were exceptions—allodial lands as they were called—but these were rare and need not trouble us. Inherent in the sovereign was the right to make grants of land to favoured subjects. These were neither free gifts on the one hand, nor sales on the other, but grants made in consideration of military and kindred services rendered and to be rendered by the grantee, the sovereign assuming the position of superior and the grantee that of vassal. There was created in the sovereign what was called an estate of superiority and in the vassal an estate of property. The original vassal, generally one of the king's nobles, in his turn made a grant of a portion of his land in consideration of similar services to a grantee of lower rank, and there was created in the original vassal a new estate of superiority, and in the new grantee an estate of property. This process, which ultimately came to be known as subinfeudation, might and did go on indefinitely, until there were between the actual owner of the land and the ultimate overlord—the king himself—many mid-superiorities, each of which was in theory an estate in land. A landowner might, until the year 1874, when making a grant of land by Feu Charter or other feu writ, forbid the grantee to subinfeudate. By the Act

of that year clauses in feu writs prohibiting subinfeudation became unenforceable.

In early feudal times there was no such thing as free commerce in land. Indeed there was a forfeiture enforceable by a Superior against any of his vassals who conveyed away more than half of the land held by him of the Superior without the Superior's consent. This also must be noted, because, after five centuries, it is still an important factor in the transfer of land; a transfer was never complete in a feudal sense till the transferee, with title duly recorded, had been accepted or recognised by the Superior as his vassal in place of the transferor—in technical terms, until the transferee had been "entered" with the Superior. In early times this entry could not be forced—a condition of things which was soon found to be wholly inimical to commercial development. The first step towards freedom was taken in 1469, when a creditor, appraising his debtor's estate, was entitled to call upon the Superior of the appraised land to receive him as vassal. But observe the condition. The creditor, as the consideration for his entry with the Superior, had to pay to the Superior a composition consisting of a year's rent of the lands. A similar composition became exigible by Superiors in respect of all entries of purchasers, unless the Superior had agreed in the feu writ granted by him to accept less. Such compositions could not be exacted under feu writs dated after the passing of the Act of 1874. Now as the result of the Feudal Casualties (Scotland) Act, 1914, all such irregular payments, including all payments prestable by Superiors at greater intervals than one year, must be redeemed before 1st January 1930, otherwise they will be held to have been extinguished. The abolition of casualties is not only relevant but important. As will be seen, it does much to clear the way for valuable reform.

The right of a creditor to compel the Superior of appraised lands to accept him as vassal suggested to the ingenious practitioners of the fifteenth century a legal fiction whereby any purchaser might, by arrangement with the seller, assume the status of a creditor of the seller, and so place himself in a position to compel the Superior to give him entry. The power of a Superior to hamper free sale by the refusal of an entry to a purchaser was gradually diminished by a series of statutory enactments culminating in an Act passed in the year 1747. This Act was important for several reasons, but chiefly because it declared clauses in Charters prohibiting sales without the Superior's consent to be unenforceable, and because it provided judicial machinery by which the Superior could be compelled to receive a purchaser as his vassal, without the purchaser having recourse to the legal fiction just referred to. Even so, the approach to free sale was timid and incomplete. Inherent in every transaction there was the idea that the lands sold had to be resigned or surrendered into the hands of the Superior, and by him granted of new to the purchaser. A century later a purchaser could enforce entry with the Superior by calling upon the Superior, under judicial sanction, and on receipt of the composition above mentioned to confirm a disposition granted by a seller to a purchaser. Thus progress towards free sale continued to be made. The process by which land

was transferred remained cumbrous almost beyond belief. Until the year 1845 no fewer than four long deeds, one elaborate ceremony to be referred to immediately, and the recording of one of the deeds were in theory required to complete a transfer of land from a seller to a purchaser, including the entry of the latter with the Superior. One of the four deeds had been in desuetude long before 1845, but three remained strictly necessary till 1858. From that date until 1874 two were essential. Since 1874 one only is required, because the recording of the Disposition by the seller to the purchaser is held to imply his entry with the Superior.

The point which the reformer of to-day must note is this: Although land transfer was simplified in 1874 as compared with 1845, the principles underlying transfer remained, and remain, the same. Nearly all land continues to be held of a Superior; in every transfer there are still four points of view—that of the purchaser, the seller, the Superior and the general public. The Superior, though shorn of much of his former power, continues to exact his feu duty with certain periodical payments so far as unredeemed, and to enforce the conditions of the Charter or feu writ in relation to the use of the land by his vassal—the owner.

Possession in Relation to Ownership.—I must here introduce the reader to another legal principle which lies deeply embedded in the jurisprudence of Scotland, a principle which must be appreciated by those attempting to reform land tenure and transfer. It is expressed in a maxim which may be freely translated thus: "It is by delivery and not by agreement that the ownership of things is transferred." That seems a rule appropriate to property capable of being passed from hand to hand, but surely inapplicable to land the locus of which is by its nature fixed. Yet the rule applies with full force to land as well as to other subjects of sale. The ratio of the principle seems to be that possession is, with certain qualifications, the ultimate test of ownership, and was in primitive times the only test. So till the middle of the nineteenth century the ceremony of symbolical delivery remained an essential alike of a grant of land by a Superior to a vassal, and of a transfer from a seller to a purchaser. The bailie or commissioner of the transferor attended on the land to be conveyed and gave to the procurator or attorney of the transferee symbolical delivery of the land by the delivery of symbols appropriate to the nature of the subjects conveyed. In early times the only record of this symbolical delivery was in the memory of the persons specially called to witness the ceremony. As commerce in land developed, and the relationships of men became less simple, this primitive record was found to be inadequate. A written record of the symbolical delivery was prepared in the form of an Instrument—one of the four deeds to which I referred—by the notary in whose presence the ceremony had been performed. Even the preparation of this Instrument was found to be insufficient in itself because of competition among grants and transfers and the want of any reliable test for the settlement of priorities among Instruments. So there were set up in the year 1617, after a long series of tentative efforts, a General Register in Edinburgh, and

Particular Registers in the head burghs of the shires of Scotland. The validity of every Instrument came to depend on its being recorded in the Register appropriate to it, at first within sixty days of its date, and later within the lifetime of the grantee of the Charter or Conveyance. The point I desire especially to emphasise here is that priorities among grants of the same land were determined not by the date of the Charter or Disposition of the lands, not even by the date of the Instrument, but by the date of the recording in the proper Register of the Instrument which was the formal record of the delivery of the land. And so title to land till 1845 in actuality, and till this day in theory, rests on (a) written grant, (b) delivery of the land, (c) the Instrument which was the record of delivery, (d) the recording of the Instrument, and (e) entry with the Superior. Symbolical delivery was abolished in 1845. Thirteen years later it became competent to record in the appropriate Register the deed of grant itself. Later still, as has been mentioned, the recording of the deed of grant implied entry with the Superior.

The foregoing survey, which does not pretend to be complete, together with the fact that the prescriptive period is now twenty years, enables one to state this proposition as applicable to transfers of land. If A desires to acquire the lands of X from B, he can safely do so, and pay the price, if B produces a valid grant or conveyance of X either in his own favour, or in favour of a predecessor with whom B is linked by intervening grants also valid. But B must also be able to show that either he alone, or he along with his predecessors in X have had uninterrupted possession of X for at least twenty years prior to the conveyance in favour of A.

The labour and expense associated with the preparation of the conveyance of X in favour of A may now be made clear to the reader. Be it observed that the grants or conveyances in favour of B, the seller, and his predecessors, if B acquired within twenty years of the sale to A, bear official declaration to the effect that they have been duly recorded in the appropriate register; but that does not imply the validity of the writ so recorded. In other words, the fact that a conveyance of X in favour of A has been duly recorded does not necessarily imply that A has an unchallengeable title to X. Our system is strictly one of Registration of Deeds, not of Registration of Title.

So it happens that A's solicitor when instructed to prepare a conveyance of X in his client's favour must begin by examining a conveyance of X duly recorded at least twenty years ago. He must follow that up by examining every deed connecting this, which I may call the initial deed, with the deed in B's favour, satisfying himself as to the validity of each. There may be in the case figured a disposition of X in favour of E in 1900, another in favour of D in 1905, and another in favour of C in 1912, and another in favour of B, the seller, in 1915. These writs must all be scrutinised by A's solicitor, whose duty it is to satisfy himself that each is valid. He must also examine all security writs which have affected X during forty years, not twenty years, prior to the transaction, to make certain that all money burdens thereby constituted have been duly discharged. He must also examine the

Record for all entries relating to X ; technically he must procure and examine Searches to ensure that no monetary burdens affect X other than those disclosed by the writs delivered by the seller, and also to make certain that no judicial bar exists to a conveyance by B, or existed to the conveyances by B's predecessors when these were granted. In the majority of cases also, A's solicitor must examine at least one old Charter or Instrument with a view to satisfying himself not only as to the casualties, if any, payable by the owners of X, but also as to conditions or restrictions on use which may have been constituted real burdens on X. This is an unexaggerated record of fact. Is it surprising that transfers even of small properties are expensive? Let it not be forgotten that this laborious investigation of title must be undertaken by every purchaser's agent, so that the writs are examined not once but many times. No conscientious agent takes deeds on trust. His duty, as things at present stand, is to examine them, and he does it. Responsibility attaches to each solicitor in turn, and few dare to take the risk of omitting the duty to examine. When a large estate is broken up, and sold in separate lots, the solicitor for each purchaser must examine the title of the whole estate in the way described. I have in mind a case within my own experience where a company purchased about half-a-dozen acres of land a few years ago. Since the purchase there have been about twenty-five sales of different lots. The common titles have been examined by about twenty different solicitors for purchasers. Not only so, but several of the purchasers have borrowed on the security of the lots purchased by them. Different solicitors have acted for the lenders, with the result that the common titles have been examined by them also. The discovery of a blunder striking at the root of a seller's or borrower's title is almost unknown, but of errors minor in degree, calling for remedy and causing expense, not a few are found. Recently I examined the titles of eight lots of ground in an old part of the city of Aberdeen. In six out of the eight errors were found, not fatal to the owners' title, but sufficiently serious to involve, in accordance with the present system of transfer, considerable expenditure to cure the defects.

Causes of Delay in Reform.—The efficiency and security of the present system are both beyond question, notwithstanding these occasional errors: nor is there any necessary lack of promptitude in the settlement of transactions. But it surely does not pass the wit of the parliamentary reformer to devise some simpler and more economic plan consistent with the highest degree of security. It will serve no good purpose to refrain from plain speaking. The structure is admirable. I sincerely admire the stern logic which has marked Scottish land tenure and transfer in their origin and evolution; but to-day it is impossible to defend methods which involve so extravagant and uneconomic an expenditure of time and labour.

One cannot refrain from asking the question: Why has reform been so conservative and so slow? Partly it is due to a deep conviction, long cherished, now slowly dying under the pressure of modern conditions. Mr Gladstone himself believed

that the prosperity of Great Britain was bound up with the preservation of great families and great estates. For centuries it was at least subconsciously held to be not only unnecessary but contrary to sound public policy to simplify the transfer of land. This view with regard to great estates reacted for a long time unfavourably on the transfer of land in towns ; but later the multiplication of conditions affecting urban subjects has in turn reacted unfavourably on the transfer of land in the country. It must be admitted too that the legal profession has done little in the past to dispel the air of semi-sanctity surrounding the ownership of land, partly no doubt through selfishness, but also because of that ingrained tendency to let well alone.

Reformers in two Camps.—Now, however, there is a growing conviction even among lawyers that the time has come for drastic reform.

Reformers are in two camps—those who believe that the existing system is capable of being so altered and simplified as to leave no cause for complaint ; others who demand a radical change. It is said by one party that if the prescriptive period were to be shortened from twenty to ten, or even seven years, the need for the uneconomic expenditure of time in the reiterated examination of writs would largely disappear, also that the forms of both property and security writs now in use are capable of abbreviation and simplification. Land is transferred to-day in a form which received statutory sanction in 1868. It again is the form introduced by Act of Parliament in 1847, modified to fit the changes marking the period between 1847 and 1868. The 1847 form was itself a modification of one in common use for many generations. And so it is suggested that commercial men seek for nothing more than a really brief and simple form of conveyance in which the number of the clauses would be reduced to a minimum, and every clause expressed in the fewest possible words, all having a carefully defined statutory meaning. This it is claimed would have the additional advantage of preserving historic continuity. No self-respecting reformer despises these impressive words, but let us not make a fetish of continuity.

Registration of Title.—I venture to think that the best legal opinion recognises the need for more than this. What is really wanted is the introduction of a system whereby the recording of a transfer of land from A to B in a Land Register will be followed by the issue of a Certificate by the Registrar in favour of B, which will, in and by itself, be a good title in favour of B to the land specified in the Certificate—the Certificate to bear *ex facie* the burdens, monetary and other, affecting the land, and to have inherent in it a guarantee of B's title to the land subject to the burdens and conditions expressed in it. Then any person dealing with B in relation to the land specified in the Certificate might do so with security, the Certificate being unchallengeable except perhaps on the ground that the transfer is a forgery, or has been obtained by fraud. A challenge of a title on these grounds is of course possible under the present system, but it is almost unknown in the Courts of Scotland. There is really no reason

why such a challenge should be more frequent under a new system.

Even the opponents of this system, which is known as Registration of Title, as distinguished from Registration of Deeds, recognise its merits. They maintain, however, that while it may be suitable for new countries—Australia or Canada where it is already in operation—it is utterly unsuitable for an old country like Scotland. We have, they point out, not only estates of property, but estates of superiority, estates of superiority not coincident with the estates of property. We have mineral rights frequently held by persons other than those who hold the land rights. We have salmon fishing rights, servitudes, money burdens, and a multiplicity of conditions affecting land impossible of expression on a Certificate of Title, and even if they could be expressed, calling for investigation by a solicitor. Besides, they say, there is the initial difficulty of expressing in a Certificate an exact description of a heritable subject sufficient to identify it, and to found a title apart from that possession on which right to land is at present so largely based.

The last is the criticism with most substance in it. It would be foolish to deny that there are grave difficulties associated with the introduction of Registration of Title, but the object is worth attaining, and the simplicity and economy of transfer which would follow would, I believe, far more than justify the initial expense.

Legislative Efforts.—I digress for a moment to mention two recent proposals for reform. There was introduced into the House of Commons in Session 1920 a Conveyancing Bill having for its main purpose the reform and simplification of land transfer. This Bill was among the innocents slaughtered at the end of Session 1920. It has since been subjected to an exhaustive examination by Committees representative of the leading legal societies of Scotland. While useful proposals are made in the Bill, these are not, as a rule, associated with the technique of land transfer, but with the reform of the general law. As a measure of transfer reform the Bill has received a cold, if not hostile, reception from lawyers. From the point of view of commercial men, it seems to me to be without value. Should it be reintroduced in anything like its present form, I think it ought to be opposed as failing to mark any real advance towards simplicity even on the old lines, and as likely, if passed, to be an excuse for delaying reform in the proper direction for another generation.

Another Bill also introduced and dropped in Session 1920 was the Land Tenure Bill. Unlike the Conveyancing Bill, it contains the germ of real reform. Its leading provisions contemplate the redemption of all feu duties, in the option of the vassal. With regard to the detail of the measure—suffice it to say that redemption was to follow on a tender to the Superior of an equivalent of the feu duty in consolidated stock. The point of great importance is the suggestion for the ultimate disappearance of estates of superiority. These incidents of Estates of Superiority—casualties, duplicands and the like—have gone or are going. When feu-duties, as such, also disappear, the battle for a simpler and cheaper system of transfer will be won.

Registration of Title (*continued*).—There is at least one obvious objection to an attempt to graft a guarantee of title on to the present system. As has already been emphasised, the foundation of an owner's right now depends in theory on a duly recorded conveyance, and possession following thereon. Possession is a question of fact, and so a right depending upon it to any extent can scarcely be guaranteed by any public official. This difficulty was elaborated and pressed by the witnesses who gave evidence before the Royal Commission on Registration of Title, and it must be admitted that if a Certificate of Title is to carry a guarantee then the Certificate must itself identify the subjects of which it is the title. While it might be possible to introduce into all Certificates of Title descriptions of heritage so exact as to permit of being guaranteed, the weight of expert testimony pointed clearly to the need for the preparation of large-scale maps as a preliminary to the establishment of a system of Registration of Title. On these Cadastral maps, as they are sometimes called in countries where the system is already in operation, there would be shown the boundaries of every property in land, represented by a number corresponding to the number of the property in the official Land Register. The opposing witnesses emphasised the great initial expense associated with the preparation of these maps, but the object is worth achieving, and the expense was, I think, over-estimated. At least the basis for such maps is to be found in our large-scale Ordnance Survey maps, and the practical identification of heritable subjects of every kind in the Valuations made under the Finance Act of 1909-1910. The Commissioners were by no means unanimous. No fewer than four separate reports were submitted on the evidence. It may fairly be claimed, however, that almost every member of the Commission accepted Registration of Title as the ideal system, and were only deterred from recommending its immediate adoption by the practical difficulties attending the change, and especially those difficulties associated with plurality of interests in land, property rights, superiority rights, and, in a minor degree, fishing and mining rights, and teinds. It is eminently noteworthy that one member of the Commission, the then Keeper of the Land Register, Mr Smith Clark, submitted a Report unreservedly in favour of the immediate establishment of Registration of Title. He claimed, and a critical perusal of the evidence leads one to think the claim well founded, that in a certain volume, called the *Search Sheet*, which has been for many years in constant use in the Register House, there is more than the nucleus of the new system. This *Search Sheet* cannot be better described than in the words of Mr Smith Clark himself :

“It is a ledger account for every unit of feudal property in Scotland which has been transmitted by purchase, disposition in security or transfer thereof, or by death during the last thirty to thirty-seven years. It makes no difference whether the unit is a large superiority with other properties combined, belonging to, say, the Duke of A, or a house of two rooms belonging to Z, forming a half-flat of a slum tenement. It may consist of minerals, whether the right is constituted by conveyance or by reservation, or of a

servitude. So long as the unit has formed the subject of constitution or transmission during the above period and has entered the register, it finds its place in the appropriate search-sheet.

"The search-sheet is brought down practically from day to day, and, besides operating as a means of identifying property on the register, it also gives the history of any particular unit of property for upwards of thirty years. The officials have therefore already in their hands (except in very rare cases) the means of rapidly and securely constructing a statement with regard to any and every unit of property (1) giving such a description of the property as has sufficed for purposes of sale, loan and transmission from time immemorial; (2) giving the name of the present owner thereof or—what is perhaps more to the point—of the person who is legally able to deal with it, and (with a small exception) any personal disability (bankruptcy for instance) by reason of which his rights or powers may be liable to modification; and (3) showing all such loans, servitudes, superiorities, and other incidents of the nature of burdens as would be revealed to an intending purchaser or lender on an examination of the progress of titles."

This *Search Sheet* may not be and do all that is claimed for it by its admirers, but without undue optimism, it does appear to make the initiation of Registration of Title with official guarantees comparatively simple and inexpensive.

Legislative Suggestions.—Indeed the only question really open appears to be whether the new system should be put into operation at once, or whether it would be better to delay for a period during which the relics of feudalism might be gradually eliminated from our system of land tenure. I cannot believe that it is necessary to wait. But, even if I am right, it is desirable that legislation should be immediately introduced on some such lines as these: a measure declaring it to be incompetent to create new estates of superiority—in other words, that an owner of land shall no longer be entitled to dispose his land in consideration of a perpetual feu duty. Land might still be sold in consideration of a price represented by an annuity redeemable at, say, thirty years, the annuity to remain a real burden on the land till redemption. Such a system could not prejudicially affect commerce in land, nor an owner's power to borrow on the security of his property. The measure might also, I think, provide for the compulsory redemption of all feu duties within a similar period on the lines of the Land Tenure Bill.

Next there should be a legislative alteration of the whole point of view with regard to the enforcement of restrictions on the use of land. At the end of the proposed redemption period the seller's interest to enforce disappears. The sound view seems to be that all restrictive conditions at any rate after the redemption period are matters of public, and not of private, concern, and should pass to the control of a public tribunal. Town Planning, Housing and Land Policy all point clearly in this direction. The result would be a diminution in the Land Register of restrictive conditions with a further step towards the simplification of Certificates of Title, and with great advantage to all dealers in land.

Comparative Simplicity and Cost.—From the point of view of simplicity a Certificate of Title from the official in charge of a Public Register, identifying the land certified, whether it be a thousand acres or one rood, expressing *ex facie* in clear language the burdens affecting the land, capable of being transferred without elaborate examination of prior Certificates, or laborious searchings of records, is so great an advance on the present system that it requires no further argument. It involves no sacrifice either with regard to security or those incidents of land ownership to which I referred at the outset. Registration of Title is consistent with the preservation of all of these. And what of the comparative cost? A conveyance of heritage worth £1000 costs the buyer and seller to-day a sum of £12 each in legal charges, on a moderate estimate. Each must pay in addition a half of the stamp duty of £1 per cent. ; and the purchaser is liable for the expense of registering the Conveyance in the Register of Sasines, varying according to the length of the deed, but averaging not less than £2, 10s. for every Conveyance. This apart from charges exigible by solicitors for arranging and completing the bargain. Under a system of Registration of Title the cost would surely be divided by two. The cost of Security Writs and of all subsidiary documents would be reduced in proportion. The advantage to the commercial man is plain. Even the solicitor need not fear. The call upon his services is so infinitely varied that soon he will wonder how he bore so long the burrowing into bundles of writs, the extravagant expenditure of time and of energy, and the torturing strain on his eyesight. If the conveyancer is never called upon to look at a Certificate of Title—I am certain this will not be his experience—there will remain writs to be framed, varied and numerous enough to satisfy the most insatiable of the breed.

Conclusion.—On many specialities, such as burgage lands, I have not touched ; but there is one other topic I must mention before bringing this article, already too long, to a close. Burdensome expense is associated with the transfer of land from a dead landowner to his trustees or to his successor, whoever he may be. I feel certain that with the introduction of Registration of Title the need for costly Notarial Instruments in favour of trustees or legatees will quickly disappear. If the wise habit of making careful testamentary provision for the disposal of heritage develops and grows, all that will be required in order to vest a successor to a registered owner will be an intimation to the Keeper of the Register hardly more complicated or costly than the intimations given to Secretaries of Joint Stock Companies with which all lawyers are familiar.

If those primarily interested in the reform of land tenure and transfer become satisfied that Registration of Title is to be their objective, they ought, I think, to make an earnest appeal for assistance to the principal legal societies of Scotland. I feel sure that unenlightened selfishness is no more a characteristic of my professional brethren than it is of any other class. The appeal will not be in vain.

LAND RECLAMATION IN THE SOUTH-EAST OF SCOTLAND.

DR. ROBERT SHIRRA GIBB.

DURING the period from 1858 to 1877 there was a "boom" in agriculture. Labour was plentiful and cheap, as of the farm servant's wages about half was paid in kind off the produce of the farm. There was little importation of food-stuffs from abroad, and, except in the lowland valleys or at the sea-board level, there was, comparatively, only small outlay on artificial manures or feeding stuffs. As industry generally was buoyant, there was a great impetus given to the production on the farm of crops for human food, and more extensive cultivation was required. The more intensive cultivation of the lowland districts reacted on the hill-sides, and caused a great deal of cropping to be undertaken at much higher altitudes than had previously been done. This was especially the case where there was naturally dry land which did not require subsoil draining, and on dry land that had been cropped during and after the Peninsular War, but had been allowed to lapse into a state of nature, more or less, in the interval. Many of the wetter parts also that had been ploughed and gathered up into the high-backed ridges, which may still be seen in places, and had been cropped about that earlier time were drained and put under cultivation.

About the latter end of that period I became interested in the processes of agriculture then in operation, and more especially in those entailed in the breaking up of heath and hill pasture for the purpose of increasing the carrying capacity of the ground as far as sheep and cattle were concerned.

It must be fairly plain to most people that the selection of the ground on which to work is very important. There were not very many moorland farms on which you could "just start with the plough." But at Boon I thought I had got what I wanted. In 1872, when I entered the farm, Boon Moor consisted of—

Whiteburn Bog	.	.	.	77'136	acres	} All within a ring- fence
Cribbs Bank and The Moor	.	.	.	485'579	"	
Corselee	.	.	.	70'251	"	
				<hr/> 632'966	"	

Deduct what is still moorland—

	75'421
	96'055
	7'950
	<hr/> 179'426
	453'540

Also there was under old grass,
and rough bent—

Boon Hill	.	.	.	{ 117'918
				3'673
Dods Hill	.	.	.	75'215
				<hr/> 196'806
				<hr/> 650'346
				acres

(NOTE.—In 1872 and for three years after the 633 acres of moorland kept twelve to fourteen score of Blackface ewes and their lambs.)

In a case like mine the fixing of the special class of moorland to put the plough into first did not occur, as, when I began, I proposed to drain and break up the whole of the moorland and also the rough, coarse hill pasture, the object being to get as much done as possible in a given time. The thing to do was to begin at the portion requiring the least amount of preliminary work, and most easily accessible. Later on I was inclined to favour beginning at the worst, or least productive, parts, as a matter of principle, on the ground that the part that was doing best meantime would continue to do so probably for a certain time, and that the part doing worst would improve most and would leave a larger margin for profit. When, later, expenses got higher and profit less that theory would not hold and only the best was worth touching at all, till eventually all such work had to be given up and those who had been most energetic were those on whom the largest loss fell. The final result is that nearly 200 acres have been left untouched, except by open or sheep draining, and parts that were improved have been allowed to go back nearly to their original condition.

There are those who have so little faith in any attempt to make two blades of grass grow instead of one that they think the breaking up of moor or hill land at this time was a mistake. On some lands it may have been, but here, though the pay was not such as was at one time expected, it has been and is a source of very considerable profit, especially now in these better times. Up to within a few years of the Great War it took, with the ever-rising expenditure and the low rate of live-stock prices, three sheep to make the profit that one did in 1872 to 1878. But the work done at that early time prevented the loss that would have occurred had it not been overtaken, though the cost of the original work remained unrepaid till the last ten years or so, and if interest had been charged during all the intervening time, it would not have been repaid yet.

Draining.—It is quite useless to break up wet land, leaving it undrained. At the beginning of the nineteenth century it was done quite often, but some means of drying it, at least partially, was generally used. For example, cutting drains in the wettest places and putting a lot of branches into the bottom of them was quite a common practice; also the “gathering up” into high-backed ridges by which a good half of the ground at any rate was made available for growing grain, while the furrow made a good runlet to take off the water. Such methods as these were wonderfully effective, but were suited only to a time of cheap labour.

At the time to which I refer—about fifty to sixty years ago—the breaking up of “new land” was common, and in fact was the recognised farm practice where there was land to operate on. I would like it to be clearly understood that I was only one of many who did it, though I happen to be one of the few still living who

came through all the bad thirty years which followed, still farming the same farm, and still able to describe the processes in more or less detail.

Many landlords were quite as interested in the work as the tenants, and in my case my landlord at the time, George, Marquis of Tweeddale, was full of sympathy, and gave much encouragement by making my lease twenty-one years instead of nineteen. He also offered to pay half of all draining and fencing expenditure, and a great deal of moorland and hill pasture was broken up. The Government was lending money for draining on the security of the property, to be paid off in twenty-five years, at a moderate rate of interest. The capital for much of the expenditure on draining land was got in this way, and a great deal of work was done, largely by "the piece" and by Irish labour.

I propose to give a practical account of what was done, and, beginning with the heather and rough, wet bent grasses, I shall describe the various processes as they were undertaken. The balance-sheets began well, but fell off woefully, and eventually all the original work was brought to a standstill.

The land under description required over almost the whole area close and regular draining, and between 1872 and 1878 over 600 acres were drained at a cost of about £6 per acre, £3000 of which was paid by the landlord. All the drains had to be under 30 feet apart, and 3 feet deep at least, and the leading drain 3 feet 3 inches deep. Except during harvest and during lying weather, about ten men on the average were constantly employed for six years doing nothing but draining, with a foreman staking off the drains and laying the tiles. The drainers were very migratory—sometimes there would be over thirty, sometimes only two or three. As wages were constantly going up, there were many strikes, and generally the men were difficult to manage, and they were not all strictly honest. On a Saturday the amount of "sub" (subsistence money) they were to get was often a difficult matter and was not always managed with success. I recollect riding fifteen miles after some members of a group to whom I had paid £5 too much, only to be told: "It's all right, master, we'll be back on Monday—shure," which, of course, did not come off.

The above 600 acres was largely moorland or rough, wet pasture, nearly all of which was eventually broken up, and indeed much of it has undergone practically the whole process except the draining more than once. Besides this a large area of the original arable land of the farm was also drained about this time and later. Breaking up new land is not an operation that comes to one naturally; to make it successful it requires to be learned. And even with the abundant advice of friends who had been at the work previously, I found that there were many details that had to be gathered from personal experience.

After the draining, and other preliminary operations such as blasting, and lifting big boulders, etc., the first proceeding is ploughing.

Ploughing and Preparing the Ground.—The ploughing was done whenever possible: in summer before harvest; in wet weather

when other farm work could not be done; in frost when other land was too hard. It may be done in the ordinary way with two good horses. If so, the plough should have a good turning mould, a broad sock, and a sharp coulter. There is no advantage—rather the reverse—in ploughing deep. The object is to get the plough slice well turned over, and to do that a wide slice is the better. Having the sharp coulter to cut the slice vertically and the broad sock to cut it horizontally helps the horses very much, especially on heather ground. It is hard work for horses and men at the best, so any appliance that tends to make it lighter has its own special use. The steam plough was hired frequently, either the ordinary double engine, or Fowler's Anchor Tackle single engine. At that time tractors were not thought of, but a tractor (one with some weight) would seem to be a likely form of power. The best plough in use on tough, hard heath was what was known as the "Sutherland Plough," from its being used by the Duke of Sutherland of the time in his breaking up land in Sutherlandshire and the north. This plough was a big, solid piece of iron, pointed at one end like the horn of a blacksmith's anvil, and put in the centre of a frame going on wooden wheels like two big drums. The anvil part of this implement tore up a slice of the moor about two feet wide, and turned it right over; the drums, carrying the weight of the implement, going, the next turn, on the top of this, completed the turning over of the slice, and pressed it down so that it lay flat with the heather side down. With two strong Fowler engines it made a very good job of about an acre and a half per day.

It was, even in these days, however, expensive work, costing up to about £4 per day. A team of cattle, in the earliest days of such work, provided by far the cheapest way of getting mountain land ploughed; but at the time I write of beef was a good price, and men to work the bullocks were not to be got.

About 100 acres would be ploughed with the Sutherland plough on the hire system; about another 100 acres would be ploughed with the ordinary double engine and tackle; while the rest was ploughed by the ordinary farm ploughmen—a man with a pair of good horses in summer would plough from $\frac{1}{4}$ to $\frac{1}{3}$ acre per day. I have said that the chief thing is to turn over the slice as effectively as possible, and to do this the ploughman had to use all sorts of expedients, which took a lot of time. Ploughing should be done if possible with a slope on the ground, so that the turning of the furrow slice would have any natural advantage to be got.

We take it now that the ground has been drained, and that it has been ploughed, however roughly. The next thing is the rotting of the sod, and time is the cheapest process. A year to eighteen months is required, and even then the second, or cross-ploughing, is not very much easier than the first, and the sods, cut into squares, lie tossed and tumbled about in all directions, and three or four double turns of the harrows are required.

All kinds of chain harrows have been tried, but they are too light, and the best implement here is what is called, for want of a better name, a "drug" or "mumbler," a heavy, sparred wooden implement about five feet square. The spars, iron-shod, trailed

over the ground, rub the sods about and make a mould better than any instrument I have tried. It is idle to say that the harrowing or "drugging" has to be done a definite number of times. Some parts require less, but others so much more. But when the surface becomes fairly loamy, then plough again; and repeat the harrowing and "drugging" and working down.

This work is all required for the first crop, which in my case was turnips, but generally in a lower country might be oats. I tried oats but found that they grew so long and were so late that there was a loss on the crop. Potatoes were not much in favour in the early days, but my later experience with growing seed potatoes on late land has not been very bad. The labour of lifting and marketing has been heavy, however, and could be done only on a very limited acreage.

If it was possible to get the new land into the loamy condition referred to during summer—*i.e.* before harvest of the year after it was ploughed—we were congratulating ourselves; generally it was some time during the second winter. But it would not work during frost now as when the old turf was whole, and at this stage the time of frost was taken up either in carting lime or in doing fresh ploughing of further new ground.

Liming.—The liming in those early days was done at the rate of 4 to 5 tons per acre. The lease of 1872, under which all this work has been done, says: "On such land lime shall be applied at the rate of not less than 5 tons per acre." This was a source of great expense, and consumed most of the profit that should have been got from this class of work, as the following approximate figures show.—

Lime per acre cost	£5
The first three times ploughing would cost about £1 per acre each	3
Harrowing and working	2
Manures, etc.	2

Making an expenditure of about £12

per acre, besides the draining, before any crop could be grown at all. It would all cost much more now. The carting of the lime shells from Chrichton Dean, about fifteen miles, was quite a big thing in itself, while other work was going on; and a whole lot of hired carters and steam wagons had to be employed to keep things going.

There is, at present, from a certain class of agricultural advisers, a lot of advice being given in favour of liming land. I claim to have experience of liming land of various classes, with a varying amount of lime, and with lime in various conditions. I have used burnt lime as lime shells at rates of from 1 to 5 tons per acre; and I have applied ground lime shells at from 6 cwts. to a ton per acre. Forty-two to forty-nine years ago I limed a large part—at least 700 acres besides all the new land I am writing about—of the arable land on this farm, at the rate of from 3½ to 5 tons per acre, at from 20s. to 25s. per ton. (This arable land was

cropped on the 5-course rotation.) The result of the heavy liming was a great wasting of the humus, and for many years poor grain crops. While, on the land specially being dealt with, lime in fair amount, say 3 tons, is a necessity, on grain-cropping land in my opinion it should be applied cautiously, and always in small quantities at a time. A ton an acre of shell lime can be put on and spread in the usual way if carefully done: $\frac{1}{10}$ cwt. put out of a cart (*i.e.* about what can be shovelled out by a square-pointed 15-inch shovel) in the middle of every 25 square yards. Have each little heap pulled close together and a little earth put on it. Follow up with a water-cart and a pail, and put about 3 gallons of water on each heap. The following day it will be so nicely slaked that the $\frac{1}{10}$ cwt. will spread very fairly and evenly over the 25 square yards. It is not safe to leave it to slake naturally, as the spreading is dependent on careful slaking; if left to nature it is about eighty chances in a hundred that it will be under- or over-done, and the spreading a failure. I tried it once in frost when there was about an inch of snow on the ground. Instead of going round with the water-cart I got a little snow swept on to each little heap. With a slight thaw overnight each heap was standing in a little pool of water in the morning; the frost in the ground prevented the water from getting away, and the lime had become mortar, and was unspreadable.

Cropping.—We may suppose that the ground is now in fair condition on the surface—that is, however many sods are below, it has a proportion of fine loam on top, and has been limed with, say, 3 tons per acre of burnt lime shells. It is now ready for a crop, and, as I have already indicated, my first crop has been yellow turnips sown broadcast. The manures applied to the turnip crop in the seventies and eighties were guano, superphosphate and bone flour, so it got about 2 cwts. of each harrowed well in with brake harrows before the seed. The seeding in those days was done by the steward himself or other expert at the rate of about $1\frac{1}{2}$ lbs. per acre—*i.e.* a pinch of seed between finger and thumb sown with a wide cast. But after some experience the seed was mixed with previously dried and riddled sawdust at the rate of $1\frac{1}{2}$ lbs. of white or Fosterton Hybrid turnip seed to the bushel of sawdust for an acre, and sown from an 18-foot grass seed barrow. Up till last year I have still sown broadcast turnips in this way, and the average in the very early years would be about 12 tons of crop per acre; later, the average would be quite 15 tons, all eaten on the ground by sheep.

As may well be understood, the turnips are small, and the work of picking up what remains of them below the ground—while the sheep are eating the shell of the turnip—is rather laborious, but against this must be put the saving of labour involved in thinning. They, of course, need no thinning, and there is no hoeing, as there are no weeds to grow on this new land. To obviate this excessive picking-up of turnip shells, experience soon showed the advantage of seeding a type of turnip that grows well out of the ground, such as Fosterton Hybrid or some similar variety. The turnips being comparatively small and close in the shaw, the frost need

not be feared. I only once, out of many hundreds of acres and over a long period of years, have had broadcast turnips frosted. High-land farmers will also understand that, the frost not being so hard, turnips on high-lying land do not frost so readily.

Sheep on this new land are, the first year, independent of wet weather; there is always enough undecayed sod in the undersoil to carry the sheep without getting sloppy. It is different the second year: they then have to fall back on the surrounding rough pasture in wet weather.

Broadcast turnips must, of course, be eaten off the ground by sheep, as they can only to a very moderate extent be pulled and stored; only by taking the biggest out of some favoured hollow may some be put together for bad weather. But they have a distinct disadvantage for sheep-feeding in that in a deep snow-storm they cannot be got. One cannot follow up a drill and pick up turnips among deep snow when there is no drill to follow!

The second year—or, counting the blank year in which the heather or spretty sod was rotting, the third year—the manuring was much the same; on the better class land perhaps not quite so heavy, being about 4 cwt. per acre of a similar mixture to that given before. In these days, of course, common basic slag is the manure to give in such cases, and nothing more is needed.

In this connection I would warn people against the unrestricted use of potash manures in such soils, and, as in the case of lime on grain-growing lands, recommend caution and experiment before spending much on potash as a manure, except on special kinds of land. At the beginning of my second lease—about twenty-nine years ago—I thought that as leguminous plants were said to need potash I would get a fine lot of clover by sowing kainit. So I ordered 120 tons from Stassfurt at about £2, 10s. per ton. I sowed it at the rate of about 1 ton to 3 acres, and about 360 acres of my pasture were top-dressed, leaving unsown patches for comparison. With the most careful watching I have never been able to tell where the kainit was sown and where not, except that in some places it clearly did harm. I have never sown a pound of kainit since, except for beans. It should be noted that on this new land, wherever the potash comes from, the nitrogen comes from the action of the lime on the decaying herbage: there is plenty of it, and to sow any more is unnecessary for the turnip crop. But I had got over all my first breaking up of moorland before I realised this and therefore wasted some money on nitrates.

The second turnip crop, which followed the year after the first, was always drilled, and even in this third year the sod was still often very tough. Perhaps the *agrostis* or moor bent roots are the worst to rot; at least I have found that pure heather ground rots easier. In any case the ground can at this stage make a fairly decent drill, though the sods may still be plentiful, and the turnip seeds braird without having the clods and the “fly” of the stiffer clay fields to worry one. And you are sure of about 18 to 20 tons of roots. But this time, of course, the turnips require singling in the usual way, though that is all that is required. You may put a plough through them and set them up a little if you like, but, as I have said, on new land weeds do not bother

much. But if done at all it should be done very lightly, as you do not want the sheep to be going among a lot of deep drills, and getting turned over and lying on their backs during winter, and a horse hoe would only pull the sods about. As the turnips are in drills as many can be stored as may be wanted: they are generally bigger individually than where broadcasted and more liable to frost, but not more than usual.

In my case, the two crops of turnips were both eaten on the ground by sheep. The ground, being separately manured for each turnip crop, was, when ploughed up after the second crop, quite fit to be seeded down, and any sods remaining were not difficult to shake out.

Seeding and Grazing.—The seeding for the most part consisted of rye-grass 1 bushel, cock's-foot 4 lbs., timothy 4 lbs. and white clover 5 lbs., and I generally sowed about 4 lbs. of rape seed per acre. It was all sown about the beginning of May and was ready for stock about the beginning of August.

It might be considered curious farming to take three Brassica crops in succession. But in this case the phosphatic manuring had been ample, and the land was fresh and not likely to be in turnips or rape again for a good many years, and it was generally a success. Later, the cock's-foot was left out and the quantity of rye-grass increased. Cock's-foot grows very plentifully on all the hedgerows at Boon—it may be considered the grass most natural to the farm; but while I know that on many farms it may be looked on as the “stand-by,” I have not sown any for many years. Personally I have always found that it usurps the position that I prefer to see occupied by grasses and clovers of a more digestible nature.

The ground was usually stocked with half-bred yearling male sheep, called “Dinmonts,” two or three to the acre, in which, in those early days, there was a great trade in autumn. They generally were ready for the butcher in October, and made from 60s. to 80s., a big price in those early days.

Rebreaking Up.—Owing to the bad seasons—in the years 1877-1879 and some of the early eighties—home produce was marketed in an immature and often in an otherwise inferior condition. That, along with other industrial conditions, gave a great impulse to the importation of the various products of the farm from abroad and reduced prices generally for the next twenty years, subject to certain minor fluctuations; so much so that landlords had to reduce rents, farmers had to reduce expenditure, and farm servants had to do with less wages. The expenditure on the land broken up remained a profitless investment. By 1900 there was a slight improvement in times, and as a great deal of the broken-up land had got so wild, with the consent of the landlord a clause was inserted in the lease, “for the purpose of improving the pasture,” allowing certain parts of the hill land, not exceeding 30 acres a year, to be rebroken up. Under this clause, for about thirteen years, beginning in 1901, from 15 to 20 acres have been rebroken up every year. The worst parts—i.e. the roughest and coarsest parts—of the various fields which were originally taken up were chosen,

and to a large extent the original process was repeated, so that "rebroken up" is the term to use.

The drains in some cases required a little renewing, but generally they were running all right. A good deal of temporary fencing was necessary: as it had to stand for four or five years, ordinary wire fencing was found to be best. The posts were good, strong Scots fir, one at each corner and one in every hollow which had to be crossed. The stobs were spruce, or silver fir, one every twelve feet. Between the stobs were put two droppers, which were hung on the wires, with small staples of No. 12 wire 1 inch long. By the time the fence came to be removed and the improved part put back into the field it was taken from—generally four years—the posts and stobs were done. The wire was, however, very little the worse, and what staples were good were kept for use again. It generally took my two men a good part of a week to put up the fence, say about 600 yards, with 8 to 10 posts at 1s., about 150 stobs at 2d., and about 300 droppers at ½d. (pre-war). There was, of course, one of these fences to put up and one to take down every year after the first four.

The ploughing was done by the farm ploughmen and was very little less hard than the original work. It generally took a man and a good pair of horses three or four winter days to do an acre. The rotting of the turf was also almost as tedious, and, as before, time was needed, and the part ploughed was left uncropped and unfenced for the first year. A part that was ploughed in winter was found by the following August to be getting quite green where each furrow slice joined its neighbour. Being a fine, tender young growth, it was much relished by sheep, which crowded on to it. It is no falsehood to say that by the month of September the same ground kept more stock than it had done before it was ploughed, though only for a month or two. The sheep-treading materially helped the rotting process, and by the resulting consolidation made the cross-ploughing easier.

If possible the cross-ploughing was done in the early winter and the succeeding wintry weather materially helped the breaking down of the sods. These sods were mostly agrostis or moorbent, with its thick, matted roots, the bane of the hill farmer's broken-up pastures. There is no class of stock that I have found which likes it, and even in the hardest winter even hill sheep fight shy of it, and, except that they may get something which is partially filling, they are really not much the better of it. It takes fair land to grow it, and I am of opinion that when it grows well the land should be good enough to grow something better.

The original processes that have been described were in every way practically repeated, but in this case the land got, as soon as it was fairly level to cart over, from 10 cwts. to 1 ton of ground lime, generally sown by a manure distributor; and for manure basic slag for the turnips instead of the old mixture, at the rate of 1 ton to 3 acres, both the year in which the turnips were broadcasted and that in which they were drilled, as already described. And the fourth year after being ploughed it was sown down, without any grain crop and generally with rape.

This rebreaking was undertaken on twelve areas between 1900

and 1913, about 165 acres being treated in the thirteen years, and though the oldest has now been sown down for fifteen years, and the latest for five years, no marks are required to define any of these areas; and though in every case the worst ground was selected, it is now the best, and shows what slag and lime and cultivation can do, and, so far as it goes, how long the benefit can remain.

Conclusion.—With regard to the financial position, I would only say that the rebreaking up having been done in a time of rising prices, whereas the original work was done in one of falling prices, naturally the former has left a profit which has materially helped to repay the expenditure of the latter; and, though the interest on the money originally expended may still be to a large extent awaiting, the farm, as I leave it next year, is immensely improved.

COMMON WEEDS.¹

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Perennial Weeds.—These are distinguished from annuals by length of life. Some are shrubs, such as gorse or whin, broom, and ling or heather, but as they occur only on very old pasture they are not dealt with here. The herbaceous perennials bear leaves, followed by flowering shoots, and the plant continues to form new buds near the surface of the soil or buried beneath it. From the point of view of treatment, the underground parts of a perennial are the more important. A grouping according to these has already been given (vol. iv., 3, pp. 287-290)—viz. tufted and shallow-rooted, tufted and deep-rooted, tufted with surface runners, creeping weeds with underground parts. As a rule a weed that lives near the surface is more easily controlled than one which is deep-rooted. Most perennials reach full development only after growing in the same place for two or more years, hence they are more common in grassland than in arable. Yet the seedlings, or new plants from fragments of the old, may become pests in arable land (coltsfoot, thistles, bindweed, etc.).

In the case of older grassland the herbage includes many plants not grasses or clovers, and opinions differ widely as to the utility of these. If they are useful herbage they cannot be serious weeds. Ribgrass plantain, yarrow, burnet and kidney vetch are sometimes regarded as weeds, yet many sheep farmers include them in sowing-out mixtures. Most grassland plants are grazed more or less by stock, and it is **only** when they occupy too much space that they become weeds. A few have been reported as poisonous or injurious to stock—*e.g.* buttercups, bindweed, ragwort, autumn crocus and the wild garlics. The following short descriptions refer to common or conspicuous intruders into arable or grass land. They are grouped according to flower colour, but it is useful to be able to recognise the leaves before flowering.

¹ This is the fourth instalment of this article.

VI.—PERENNIAL WEEDS WITH YELLOW FLOWERS.

Buttercups.—The buttercup flower is nearly flat, yellow (except in water forms), and the numerous stamens surround a group of small fruits which ripen as "seeds."

Creeping Buttercup (*Ranunculus repens*) is the common one with runners that extend along the surface of the ground, rooting at intervals (Fig. 15). Its natural home is moist places amongst grass and other herbs, but it may extend into arable land where



FIG. 15 —CREEPING BUTTERCUP. FLOWERING SHOOTS FROM A RUNNER.

(*Common Weeds*, H. C. Long.)

the runners favour a rapid extension. The buttercups of old grassland may be either the Upright Buttercup (*R. acris*), or the Bulbous Buttercup (*R. bulbosus*), the latter distinguished by a nut-like base buried about an inch in the soil, and by its flowers with the green sepals turned downwards. If the three species are found together in old grassland with ridges and furrows, the creeping buttercup generally follows the moister depressions, the upright one is on the slopes of the ridges, and the bulbous one is on the drier ridge-tops, which suffer first from drought. The abundant flowering of buttercups indicates that they are not much grazed,

and there is a general opinion that they are disliked, and that if eaten by animals newly brought on to the land they may cause trouble.

In grassland, ploughing up is almost the only treatment for buttercups, though they may be suppressed by manuring to encourage grasses, and improved drainage will check creeping buttercup. The fruits are not uncommon impurities in seeds, and in this way buttercups may become weeds in young grass.

The Annual Buttercup (*Ranunculus arvensis*) is a cornfield weed rarely seen in Scotland. It has small buttercup flowers, deeply cut leaves, and large spiny fruits (about $\frac{1}{4}$ in. diam.), which occur in seed-corn.

Coltsfoot (*Tussilago farfara*), one of the Compositæ, is a pernicious weed known locally as "tushielagy" or some similar name. The long and deep-rooted white underground stems give off, early in the year, tufts of flower-heads borne on a stalk about



FIG 16 - COLTSFOOT IN MARCH, WITH CREEPING ROOTSTOCK AND TUFTS OF FLOWERING HEADS

(Common Weeds, H. C. Long)

6 in. high (Fig. 16). Later the fruiting heads elongate and bear a white ball of "seeds," each a narrow elongated fruit with a downy parachute for wind dispersal. The leaves appear in summer with large entire blades, somewhat hoof-shaped, and densely covered with white down on the under surface. The widely spreading underground system is favoured by deep, loose soils, such as tip-heaps, banks where road scrapings are thrown, and clay-slips, but when the land becomes consolidated coltsfoot tends to disappear. In ploughland the old plants must be broken

up by deep ploughing, etc., so as to bring the white rootstocks to the surface to be harrowed off. This treatment is rarely sufficient, as new leaves arise from broken fragments left in the soil. If a root crop is taken the usual cultivation will uproot many of the young plants, but in a corn crop they quickly become deep-rooted again. Although coltsfoot is not uncommon in young grass, it is generally suppressed and is not common in older grassland, except about margins and gates.

Ragwort (*Senecio jacobea*) has many local names: tansy, weeby, ragweed, yellow weed, staggerwort, etc. It is a persistent weed in pasture land, recognised by its height (1-2 feet), the deeply cut leaves and the crowded yellow flower-heads (Fig. 17). The stems are tough and arise from a deep-rooted crown, without runners, but prolific in buds. The flower-heads consist of numerous yellow disc and marginal florets (Compositæ), and each head produces numerous plumed seeds in late summer.

Ragwort is found mainly in old grassland on poorish soils, or where the surface soil is impoverished. Abundance denotes a cow pasture, and its absence is very marked where sheep graze. The reason is seen on examining a well-stocked sheep pasture eaten bare, say in March or April; the crowns of the ragwort are closely grazed and the white, fleshy part is deeply bitten into. The heavy stocking of the lower sheep fields keeps down the ragwort and prevents it flowering that season. Cattle avoid the plant, and various observations suggest that it is more or less poisonous to them. In cattle districts the plant is cut during summer to prevent seeding, but this has little effect on the crowns and buds, as the larger leaves are produced near the soil. Sheep-grazing is much more effective. When the grassland is ploughed up this weed almost disappears during the rotation years. Its reappearance when the land is laid down to grass again must be due to



FIG 17 —RAGWORT. UPPER LEAVES, FLOWER-HEADS AND A SINGLE FLORET
(*Standard Cyclopædia of Agriculture.*)

blown seed, because ragwort seeds are not common impurities of grass or clover seeds.

Dandelion, Hawkweeds and Hawkbits.—These names are used to include the true dandelion and several other very similar Compositæ, including Autumn Hawkbit (*Leontodon autumnalis*), Cat's-ear (*Hypochaeris radicata*) and others that frequent old grassland. The flowers differ in details, but consist of numerous yellow florets, all strap-shaped, there being no disc florets such as occur in the daisy head. All have plumed fruits for wind dispersal, and the leaves arise from deep-rooted crowns. The Mouse-ear Hawkweed (*Hieracium pilosella*), a common weed on dry pastures, has distinct surface runners and pale yellow flowers. None of them are common on arable land, except as seedlings. These weeds are not grazed by stock, hence they seed freely and tend to spread. Manuring the pastures or changing from pasture to hay, after manuring to encourage grasses and clovers, will check weed growth to some extent, but ploughing up would be better.

Perennial Sow-thistle (*Sonchus arvensis*).—This closely resembles the annual milk- or sow-thistle (see vol. iv., January 1921, p. 9, Fig. 3), but differs in having strong underground creeping stems which are difficult to eradicate. Treatment is similar to that recommended for other deep-rooted perennials such as colts-foot and field thistle.

Silverweed (*Potentilla anserina*).—A conspicuous plant about gates and field sides, but not often a serious weed. The feather-cut leaves, silvery white on the under surface, are easily distinguished (see Fig. 14, vol. iv., July 1921). The plant rarely bears seed on farmland, but about sea beaches abundant seeds are produced. On the farm it is mainly distributed by pieces of the long creeping surface runners being carried about. The shallow root system renders the plant easy to check on arable land.

Yellow Rattle (*Rhinanthus crista-galli*) is a weed which draws nourishment from the roots of other plants in grassland (see Eye-bright in white-flowered perennials).

VII.—PERENNIAL WEEDS WITH WHITE FLOWERS.

Ox-eye Daisy or Marguerite (*Chrysanthemum leucanthemum*).—This is distinguished from the horse gowans or mayweeds (vol. iv., January, pp. 9-11, Fig. 4) by its perennial habit, only a certain number of the leafy rosettes flowering each year. The flowering shoots are tall, up to about 2 feet, and look rather bare because of the small leaves; the flowers are conspicuous with large white marginal florets. The plant has no runners, but the abundant production of new rosettes of leaves leads to the formation of large patches that crowd out grasses and clover. During the past dry summer fields have been seen white with marguerites, which flowered abundantly, whereas the grass suffered from drought. This weed produces abundant minute ribbed seeds, with no plume, and these are common impurities in grass seeds. Close grazing with sheep in spring will do much to check the growth of flowering shoots, and where the ox-eye is too abundant it might be advisable to miss a hay crop for a year, continuing the grazing through the

whole season. Its presence indicates poor nutrition of grasses, hence the usefulness of top-dressing for hay with farmyard manure or with artificials (superphosphates 2-4 cwts., and sulphate of ammonia 1 cwt.). Patches of ox-eye have been eradicated by heavy dressings of common salt (6 cwts. per acre). Where a whole field is infested, ploughing and cropping would be more effective.

Common Daisy (*Bellis perennis*).—This is more common as a pest in lawns and park grass. It is treated on the same lines as ox-eye daisy, by grazing with sheep or by top-dressing. "Lawn-sand" is a winter top-dressing, consisting generally of a mixture of sulphate of ammonia and sand or fine ashes.

Yarrow or Milfoil (*Achillea millefolium*) is conspicuous in grassland by its finely cut leaves and small white flower-heads grouped closely together. Opinions differ as to its value, but sheep farmers generally like it in pasture. Where sheep pasture fields are closely grazed in spring, yarrow returns quickly and thus shelters the slower growing grasses and clovers. If the pastures are not closely grazed, yarrow tends to become rank and to oust better herbage. It is of little value in hay as its growth is almost confined to the bottom.

Sneezewort (*Achillea ptarmica*).—The flowers resemble yarrow, but are larger and more distinctly white; the leaves are narrow, not divided, and saw-toothed on the margin. The whole plant is more stiffly erect and is common on peaty soils about ditches. In recent years it has been observed as an abundant field weed on upland farms on moor soils, where its presence indicates need of fertilisers, such as basic slag.

Kecks or White-flowered Umbelliferæ.—This group includes several large, conspicuous plants, more prominent about field margins and hedges, but sometimes weeds in old grassland, less often in arable land. They are distinguished by the numerous small flowers grouped closely into small umbels, and these again into larger umbels (Fig. 18). The short stalk to each floret is characteristic of the Umbelliferæ and distinguishes them from the Compositæ, where the florets have no stalks and are crowded into daisy or dandelion heads. Each fertile floret produces a double fruit, attached closely together in flower, but separating on ripening into nutlets or "seeds," resembling those of the garden carrot, parsley or parsnip.

(a) Cow Parsnip or Hogweed (*Heracleum sphondylium*) is a large plant, 3 feet or more high when in flower, with leaves up to 2 feet long (Fig. 18).

(b) Bishopweed or Goutweed (*Egopodium podagraria*) is a notorious pest in gardens surrounded by hedges, and about stack-yards. It has widespreading underground stems, like coltsfoot or nettle, very difficult to eradicate. The leaves are divided into broad segments, not unlike those of hogweed, but they are bright green and shining. The flowering stems are about 2 feet high, with whitish, not very conspicuous flowers.

(c) Hedge Parsley or Chervil (*Anthriscus sylvestris*, etc.).—These are common tall hedgerow weeds with large leaves finely divided and fern-like. The commoner species has elongated

smooth fruits, but others have shorter burr-fruits covered with fine hooks. In some old pastures they may become weeds.

(d) Earthnut, Arnut or Pignut (*Conopodium denudatum*) is a small plant common in old pastures. When in flower it is about



FIG. 18.—COW PARSNIP OR HOGWEED.
FLOWERING SHOOT (REDUCED IN SIZE) AND
A SINGLE FLOWER (ENLARGED).

(Common Weeds, H. C. Long.)

a foot high, with small flower-heads and a few leaves cut up into thread-like segments. Two or three inches in the soil there is a brown tuber about the size of a chestnut and not unknown to country boys.

(e) Hemlock (*Conium maculatum*).—A poisonous species, tall and with finely divided leaves like the hedge parsleys, but distinguished by purplish spots on the lower stems. The plant is rather uncommon, but often abundant where it does occur, for instance, about farm rubbish heaps and waste ground. It is a biennial, flowering in the second year, and as it is not deeply rooted it can be pulled up entire in wet weather.

(f) Water Dropwort (*Enanthe crocata*), another tall, poisonous species, frequenting marshy places along rivers. It can be distinguished by the large, white, fleshy tubers, 2-4 inches long, like those of the garden dahlia. The roots and leaves of this and other marsh Umbelliferae are known to be poisonous in a high degree. Cattle accustomed to the place do not seem to be much affected, but cases have been recorded of death

following the eating of the root tubers thrown out in cleaning ditches. It would therefore be advisable to fence off marshy places where these plants grow.

Campions.—The seeds of several species are common impurities in clover seeds and are thus introduced with grass mixtures. They are about the size of red clover seed, but can be distinguished

by the black or brownish seed-coat covered with rough, blunt spines. Campions have the leaves arranged in pairs, and the flowers are large ($\frac{1}{2}$ to 1 in. in diameter). Bladder Campion (*Silene inflata*) has a wide, bladder-like calyx fitting loosely round the white petals. White Campion (*Lychnis vespertina*) is more erect and robust, the calyx fits closely and the flowers have a fragrant smell, especially at night. Another white campion has white flowers that always appear withered; this one comes with clover seeds, hence is generally found in young grass. Red Campion (*Lychnis dioica*) is generally a woodland plant and often conspicuous in wood clearings. These weeds are checked by cutting hay before the seeds ripen and by grazing the aftermath. They are not often troublesome weeds in ploughland, and as they are not deep-rooted should be fairly well cleaned out during a cropping rotation.

Wild Garlic (*Allium vineale*) is easily distinguished by the strong smell of onions when bruised, by the long narrow leaves and by the close tuft of whitish flowers. Another species common about woods has broader leaves. Garlic generally occurs in pastures, and the milk of grazing cows acquires the garlic flavour. Propagation takes place by seeds, and by "cloves" or swollen seed-like buds formed in the flower-head or near the base of the plant. The underground parts are deeply rooted bulbs which give off new bulbs; hence garlic generally occurs in patches. Experiments at Woburn showed that the best control is to plough up and sow down with a heavy grass mixture of the "Elliot" type, which smother the garlic in about six years.

Eyebright (*Euphrasia officinalis*) is a conspicuous white-flowered weed (Fig. 19) on many pastures with short herbage. Although a small weed, its roots draw nourishment from grasses, etc.; hence it is injurious to the herbage. Another partially parasitic weed is Yellow Rattle (*Rhinanthus crista-galli*), in pastures or in meadow hay. The plant is taller than eyebright, with narrow elongated leaves and pale yellow flowers; the seed-capsules, about $\frac{1}{2}$ in. in diameter, are flattened and enclose flattened seeds which rattle in the ripe capsule. These weeds may be regarded as signs of poverty, to be suppressed by manuring to encourage grasses and clovers. Close grazing with sheep will often improve the herbage and check the weeds.



W. S. W. 1888

FIG. 19. —EYEBRIGHT. PLANT, FLOWER AND FRUIT.

(Common Weeds, H. C. Long.)

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VIII.—PERENNIAL WEEDS WITH RED OR BLUE FLOWERS.

Thistles.—As weeds of the farm, only two of the numerous species are common. Creeping or Field Thistle (*Carduus* or *Cnicus arvensis*) is a stubborn perennial weed with long, deeply rooted underground parts. Compared with the Spear Thistle (see below),



FIG. 20 SPEAR THISTLE.

(Common Weeds, H. C. Long.)

this species has thinner stems, is less spiny and the flower-heads are distinctly smaller and less showy. The florets form compact heads and belong to that section of the order Compositæ which has the petals of each floret joined into a long tube, there being no strap-shaped florets as in a dandelion or the marginal florets of a

daisy. When ripe the heads bear a mass of cottony pappus, the parachute for seed dispersal, but if examined it will often be found that there are few fully formed fruits (seeds). This supports a common opinion that this thistle does not spread by seedlings, but occasionally heads may be found with some ripe fruits, which can be germinated. The first appearance of thistles in a field may be from seedlings or from pieces of the rootstocks carried on to the field. They soon spread to become a patch which may consist of a single continuous plant covering square yards. This thistle is a perennial bearing both leafy shoots and flowering ones, and although the latter die after flowering, they are soon replaced by buds arising from their base. Buds may also arise from any fragment of the underground rootstock. Treatment consists mainly in eradicating the green shoots so as to starve the underground parts. When flowering thistles are cut, the stems still contain enough nutriment to ripen the heads, but stems under a foot high are in a good condition for cutting, and if they can be cut more than once a year, so much the better. Hence root crops with frequent cultivation are the farmer's opportunity. On the other hand, corn crops protect the thistles, though much may be done by spudding or hand-pulling before flowering. On grassland cattle keep down thistles better than sheep, because they graze the young shoots. Or if pasture is allowed to grow as meadow hay early cutting checks the main crop of thistles for that season. This thistle is often attacked by a chocolate-coloured rust seen as a coating on the lower surface of the leaves, and these shoots have a starved, lean appearance and shrivelled flower-heads. Following up this clue, experiments have been made by mixing the rust spores in water and spraying young thistles; the result was a rapid infection of the plants followed by the starved growth.

Spear Thistle (*Carduus lanceolatus*), often called Scotch Thistle. The plant is a biennial which in the seedling year forms a rosette of large leaves close to the ground; next season most of these



FIG. 21.—FIELD BINDWEED. PLANT AND PORTION OF UNDERGROUND ROOTSTOCK.

(*Standard Cyclopædia of Agriculture*.)

rosettes produce tall, flowering shoots, then the plant dies away entirely. The heads are large, rounded and tipped with the conspicuous purple flowers (Fig. 20). Each head forms abundant oval, smooth and plumed fruits. These are not uncommon in



FIG. 22.—FIELD MINT
(*Common Weeds*, H. C. Long.)

grass and clover seeds, hence this thistle is more abundant in young grass than in other arable crops, and it continues to seed itself on older grass. Deep spudding in the leafy or first year will destroy the plant. Sheep often bite deeply into the crowns during winter and thus prevent flowering next season.

Marsh Thistle (*Carduus palustris*) is a tall, conspicuous spiny species with purple or whitish flowers; it frequents wet pastures.

Hardheads or Horns'-knots (*Centaurea nigra*).—These weeds have firm thistle-like heads of purple flowers, but neither stems nor heads are spiny, and there is only short down attached to the seeds. The plant grows from 12 to 18 inches high, generally in rough grassland or about roadsides. The underground parts are strong but not deep, so that in ploughland with cultivation it is kept in control. In grassland hard heads are generally more abundant on a cow pasture than where sheep graze (see Yellow Ragwort). Summer mowing before flowering will help to check this weed.

Field Bindweed (*Convolvulus arvensis*).

—This is distinct from Black Bindweed, an annual with clusters of small reddish flowers (vol. iv, No. 2, April 1921, Fig. 8). The field bindweed is a perennial with large pink or whitish pink flowers (1 inch across), the petals forming a cup similar to, though smaller than, the handsome white convolvulus fairly common as a climber about garden fences. The pink bindweed



FIG. 23.—SELF-HEAL.

(*Standard Cyclopædia of Agriculture.*)

has broadish leaves, somewhat arrow-shaped (Fig. 21). The slender stems twine round corn, etc., or form tangled mats on the soil. The seeds resemble small shrivelled seeds of tare, dark and somewhat triangular; they occur in samples of grain from infested fields. If large numbers of the seeds are ground with corn, the flour or meal is spoilt in colour and is probably unwholesome, because bindweed seeds are reputed to be poisonous. This weed is a pest, because the slender white rootstocks wander far and wide underground and throw up new shoots. These grow more vigorously in light soils, but the weed may occur on any soil. In the lighter soils it occurs both in arable and in grass land, but on heavier soils it is more an arable weed. In Scotland bindweed tends to follow the farms along the sea-coast. Control

is by deep ploughing and cultivation, followed by harrowing off the rootstock into heaps. This is easier to do in light soils than on heavy, which hold the broken fragments. Root-crops offer a good opportunity for checking this bindweed.

Field Mint (*Mentha arvensis*).—This has square stems with opposite leaves and small lilac flowers (Fig. 22). When bruised it has the odour of mint, but not so strong as the garden mint. It is mainly spread by the underground rootstocks, whitish stems, $\frac{1}{4}$ to $\frac{1}{2}$ in. in diameter, seen when ploughing, often just below the plough-sole, so that they are little damaged. This suggests the advisability of deeper cultivation to bring up the rootstocks. The weed flourishes well on heavy, wet soils, where it is not so easily turned out as on lighter soils. Control follows the suggestions given above for bindweed or for coltsfoot.

Self-Heal (*Prunella vulgaris*).—Local names such as poverty pink, Carmyllie clover and blaw-weary indicate this as a weed of poorish or run-down land. The seedlings are not much trouble on arable land, but in grassland this weed is widespread. It has the same opposite leaves and square stems as mint, but the reddish-blue flowers are gathered closely together at the top of the shoots (Fig. 23). The seeds are common impurities in clover seeds, and in this way self-heal is introduced as a weed in young grass. The seeds are brown, with a dark network, and at one end a small white knob, the whole not unlike a tiny brown beetle with a whitish head. The seedlings form tufts of short creeping rootstocks on or near the surface. Self-heal becomes established where grasses and clovers fail, hence it occurs where corn has been laid or where stooks have stood too long. In older grassland this weed means poverty, with the ground poorly covered, and it suggests the advisability of ploughing up or top-dressing to encourage more useful herbage.

Docks and Sorrels often have reddish flower-heads when ripening seed, but they are described in the next group, the perennial weeds with greenish flowers.

THE INFLUENCE OF THE WAR ON THE COST OF MILK PRODUCTION.

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SINCE the year 1908 a large amount of information has been collected by the Department of Agriculture of the University of Leeds as to the varying costs of the production of milk on various farms throughout Yorkshire. Since throughout the whole of the investigations these costs have been found to vary between the extreme limits of 3½d. and 4s. 7½d. per gallon, it would be interesting and instructive, did space permit, to trace out all the various

1921] THE COST OF MILK PRODUCTION.

factors which have been found to influence the costs of milk production, and to see how far these factors have been under the control of the milk producer.

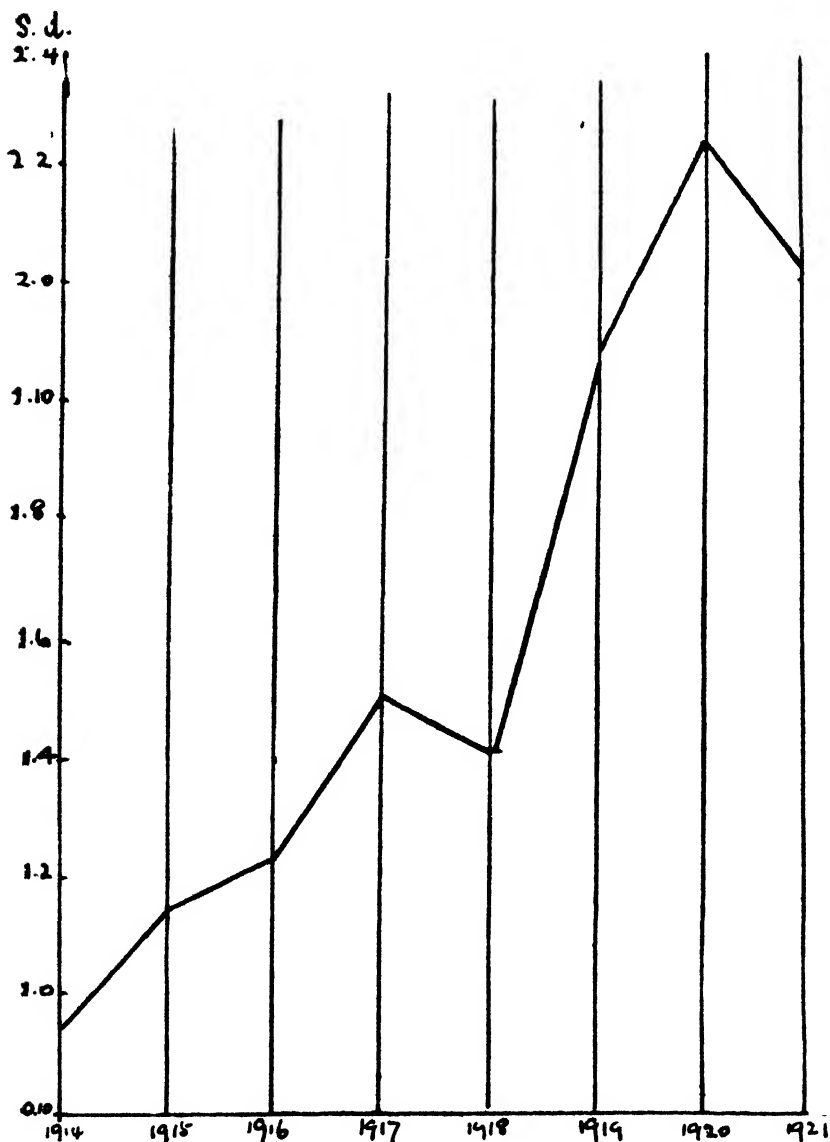


DIAGRAM 1.—YEARLY VARIATIONS IN COST OF MILK PRODUCTION ON FARM H.

Black line indicates rise in cost of Milk Production on farm H. since the outbreak of the war.

Actually these factors divide themselves up, quite naturally, into three groups:

- (a) Those which are *not* under the control of the producer.

(b) Those which are *partially* under the control of the producer.

(c) Those which are, if not *entirely*, at all events to a *large extent*, under the control of the producer.

In the present communication it will be possible to deal only with the first group.

On several of the farms in question it has been found possible

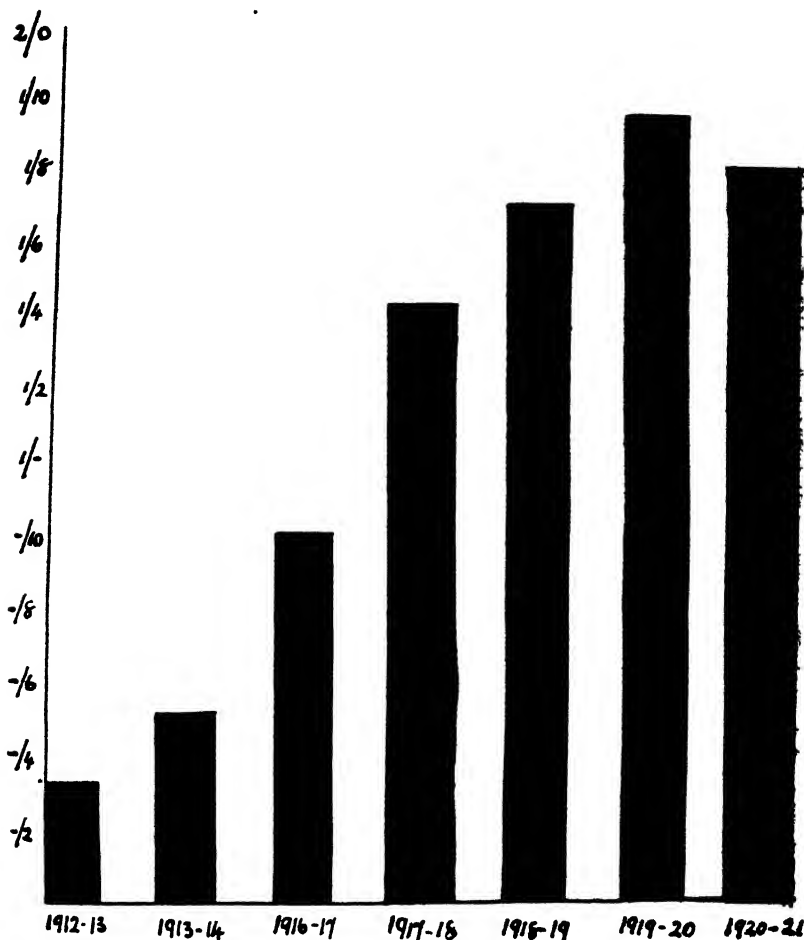


DIAGRAM 2.—YEARLY VARIATIONS IN COST OF MILK PRODUCTION PER GALLON ON FARM B.

to follow up each year from 1912 to the present time the cost of producing milk. In every case it has been found that since the outbreak of the war these costs have increased, rarely less than 200 per cent., usually 300 per cent., and occasionally as much as 400 per cent.

Thus on farm H., a small grass farm near Halifax, these costs have increased, as is shown on Diagram No. 1, from 11½d. per gallon in 1913-1914 to 2s. 2½d. per gallon in the year 1919-1920.

1921] THE COST OF MILK PRODUCTION.

On farm B., a mixed farm in the North Riding, milk was produced (see Diagram 2) in the year

1912-1913	at	3½d.	per gallon
1913-1914	"	4½d.	" "
1916-1917	"	10d.	" "
1917-1918	"	1s. 4½d.	" "
1918-1919	"	1s. 7d.	" "
1919-1920	"	1s. 9½d.	" "
1920-1921	"	1s. 8d.	" "

On farm C., a mixed farm in the industrial area of the West Riding, the cost of producing milk in the year

1912-1913	was	4½d.	per gallon
1913-1914	"	6½d.	" "
1914-1915	"	7½d.	" "
1915-1916	"	8½d.	" "
1916-1917	"	10½d.	" "
1917-1918	"	1s. 6d.	" "
1918-1919	"	2s. 4d.	" "
1919-1920	"	2s. 6d.	" "
1920-1921	"	2s. 2d.	" "

These increased costs of production, as can be seen from Table I. and Diagram 3, are due mainly to the following causes :—

- The increased labour bill.
- The increased food bill.
- The increased depreciation of the cows.

TABLE I.

Variations in Yearly Cost of Upkeep per Cow. Farm C.

	1912-13.			1919-20.		
	£	s.	d.	£	s.	d.
Annual Labour Bill per Cow	2	12	0	10	3	4
" Food " " " " " " " " " " " "	8	15	0	36	2	8
" Depreciation " " " " " " " " " " " "	0	9	6	11	13	8
" Incidental Expenses " " " " " " " " " " " "	0	12	1	2	2	0
Total Yearly Cost of Upkeep	12	8	7	60	1	8
Weekly Cost of Upkeep	0	4	10	1	3	1
Cost of Production of Milk per Gallon	0	0	4½	0	2	6

(a) THE INCREASED LABOUR BILL.

In pre-war days the average farm labourer would receive as wages approximately £1 per week, or from 3s. to 3s. 6d. per work-

ing day. At the present time his average wage is nearly £3 per week, paid partly in cash and partly in kind, and on the farms at present being costed through the Department of Agriculture of

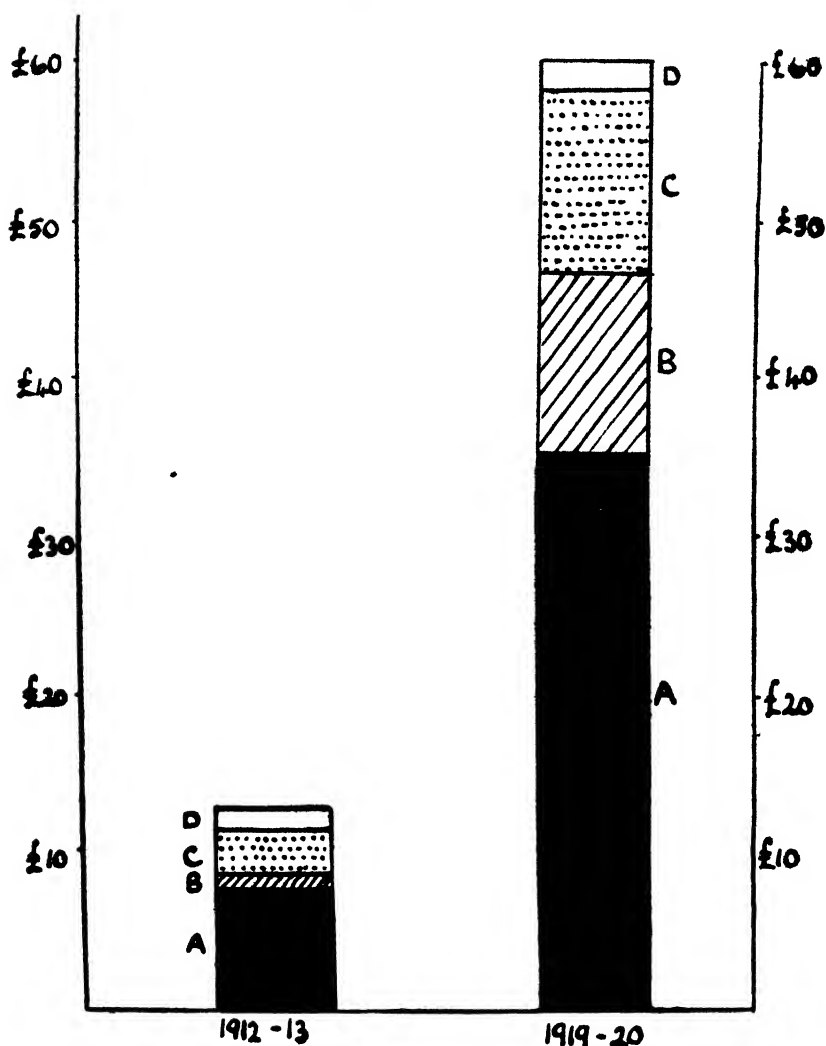


DIAGRAM 3.—COMPARISON OF PRE-WAR AND POST-WAR YEARLY COST OF UPKEEP PER COW ON FARM C.

A, Food Bill. C, Labour Bill.
B, Depreciation. D, Incidentals.

the University of Leeds is varying roughly from 9s. to 10s. 6d. per working day. On one farm of 312 acres, in the neighbourhood of Leeds, the yearly wages bill in 1912-1913 was £596, 9s. 7d. or £1, 18s. per acre. In 1919-1920 it had increased to £1650 and corresponded to £5, 3s. per acre.

On a second farm, on which the accounts have been regularly

followed up, the average weekly wage bill was £11, 8s. 6d. in 1915 and £37, 2s. 11d. in 1919.

On farm M., a milk-producing farm of 354 acres in the East Riding, the labour bill has increased from £911, 2s. 5d. or £2, 12s. per acre in the year ending 31st March 1914 to £2291, 19s. 1d. or £6, 10s. 6d. per acre for the year ending on the corresponding day of 1920. Details of the yearly variations of the labour bill on this farm are given in Table II.

TABLE II.
Variations in Labour Bill. Farm M. 354 Acres.

Year ending 31st March.				Total Wages Bill.			Wages Bill per Acre.		
				£	s.	d.	£	s.	d.
1914	...	...	...	911	2	5	2	12	0
1915	...	...	...	971	9	1	2	15	4
1916	...	...	...	1153	2	5	3	5	9
1917	...	...	...	1274	0	9	3	12	6
1918	...	...	...	1694	2	2	4	15	9
1919	...	...	...	1755	7	7	5	0	8
1920	..	...	..	2291	19	1	6	10	6

On several of the farms on which the varying costs of milk production have been investigated detailed time sheets have been kept. The analyses of these have shown that on the average there is utilised in attention to each cow a yearly equivalent of twenty-four days' labour for a man and four days' labour for a horse.

The cost of horse labour on the farm has also increased per working day from approximately 2s. 6d. in 1914 to 6s. in 1920.

The increased cost of labour in attention to the cows has been responsible for the fact that on farm B. the yearly labour bill per cow was £13, 4s. in 1920 as compared with £4, 2s. in 1914. On this farm the labour bill increased from 1s. 8d. per cow per week in 1914 to 5s. in 1920, and corresponded to 5½d. per gallon of milk produced in 1920 as compared with 1½d. in 1914.

TABLE III.
Influence of Labour Bill on Cost of Milk Production. Farm B.

		No. of Days per Cow per Year.	Cost of Labour.						Per Gallon of Milk:					
			Per Cow per Year.			Per Cow per Week.								
			1913-1914.		1919-1920.		1913-1914.		1919-1920.		1913-1914.	1919-1920.		
			£	s.	d.	£	s.	d.	s.	d.	d.	d.		
Labour—			3	12	0	12	0	0	1	5	4	7	1'5	5'1
(a) Man ...	24		0	10	0	1	4	0	0	3	0	5	1'2	0'5
(b) Horse ...	4													
Total Labour ...			4	2	0	13	4	0	1	8	5	0	1½	5½

As a general rule it may be stated that while the labour bill for attention to cows varied in pre-war days from 1s. 6d. to 2s. per cow per week, or from 2½d. to 3½d. per cow per day, at the present time it will amount to from 4s. 6d. to 6s. and occasionally as much as 7s. per week, or from 8d. to 10d. and occasionally as much as 1s. per day. This increased labour bill has added 4d. per gallon to the cost of producing milk over the cost in pre-war days.

(b) THE INCREASED FOOD BILL.

I. **Grazing.**—In spite of the fact that rents up to April 1920 remained approximately where they were before the war, the increase in the cost of artificial fertilisers and of the rates and labour on the grass land, coupled with the added cost of producing dung, have increased the cost of grazing by usually 50 and in some cases 75 per cent.

Thus on farm B. the cost of grazing amounted during the summer of 1919 to £4, 4s. 9d. per cow as compared with £3, 0s. 6d. during the summer of 1914.

On farm A., as can be seen from Table IV., the cost of grazing per acre was £2, 16s. in the summer of 1914 and £3, 14s. 8d. in the summer of 1919; the cost of grazing 2s. 10d. per cow per week in 1914, 4s. 4d. in 1919; the cost of grazing per gallon of milk produced, when the cows were on grass, 3d. per gallon in 1914 and 4½d. per gallon in 1919.

TABLE IV.

Comparative Costs of Grazing. Farm A.

	Cost per Acre.			Cost per Cow per Week. Summer Months.		Cost per Gallon of Milk produced when Cows on Grass.	
	1914.	1919.		1914.	1919.	1914.	1919.
	£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Rent	1 9 8	1 9 8	1 8	1 9	...	...	...
Rates	0 5 6	0 7 6	0 3	0 5	...	...	...
Manure	0 15 0	1 4 7	0 8	1 5	...	...	...
Incidentals ...	0 1 0	0 1 4	0 0½	0 1	...	...	...
Labour—(a) Man ...	0 3 2	0 9 0	0 1½	0 6	...	...	...
(b) Horse ...	0 1 8	0 2 7	0 1	0 2	...	...	...
Total Cost	2 16 0	3 14 8	2 10	4 4	0 3	0 4½	

Approximately it may be stated that the cost of grazing was £1 per acre more in the summer of 1919 than in the summer of 1914, although the rent had remained unchanged. As each cow on the farms costed has, on the average, had the grazing of an acre and a half, this would mean that the yearly cost of grazing had increased

by approximately £1, 10s. per cow since the outbreak of the war. This average additional yearly cost of £1, 10s. per cow for grass has added another $\frac{1}{2}$ d. per gallon to the cost of producing milk, when that cost is distributed over the whole year, or $1\frac{1}{4}$ d. per gallon if charged to the summer months only.

2. **Home-Grown Foods.**—When it is remembered that the average cost of man labour was 3s. per working day in 1914 and 9s. in 1920; that the cost of horse labour had, during the same period, increased from 2s. 6d. to 6s. per working day; that the price of artificial manures had gone up at least 100 and in many cases more than 200 per cent.—(to quote only one example) basic slag, which could be bought in 1914 at £1, 15s. per ton, was in 1920 fetching £5, 5s.—and that the seed bills of the various crops are roughly three times what they were in pre-war days, it can readily be seen that the increased cost of production of the home-grown foods fed to the cows is another factor which has been instrumental in increasing the cost of milk production.

Thus on farm B.—

Roots were produced in 1914 at 12s. 6d. per ton; in 1919 at £1, 11s. 2d. per ton.

Hay was produced in 1914 at £1, 16s. 6d. per ton; in 1919 at £3, 11s. 7d. per ton.

Oat Straw was produced in 1914 at £1, 10s. per ton; in 1919 at £3, 2s. 4d. per ton.

TABLE V.

Comparative Costs of Producing Roots. Farm B.

	Cost per Acre.					
	1914.			1919.		
	£	s.	d.	£	s.	d.
Rent	1	8	6	1	8	6
Rates	0	7	1	0	12	6
Manure	3	4	0	6	11	6
Seed	0	4	0	0	9	6
Standing Charges	0	6	11	0	9	0
Labour—(a) Man	5	12	0	10	12	0
(b) Horse	1	7	6	2	17	0
Total Cost per Acre	12	10	0	23	0	0
Cost per Ton	0	12	6	1	11	2

TABLE VI.

Comparative Costs of Producing Hay. Farm B.

	Cost per Acre.					
	1914.			1919.		
	£	s.	d.	£	s.	d.
Rent	0	19	0	0	19	0
Rates	0	4	9	0	8	4
Manure	0	9	6	1	0	6
Standing Charges	0	4	7	0	6	9
Labour—(a) Man	0	6	8	0	18	11
(b) Horse	0	4	0	0	9	9
Total Cost per Acre	2	8	6	4	3	3
Cost per Ton	1	16	6	3	11	7

TABLE VII.

Comparative Costs of Producing Straw (Oat Straw). Farm B.

	Cost per Acre.					
	1914.			1919.		
	£	s.	d.	£	s.	d.
Rent .. .	1	8	6	1	8	6
Rates	0	7	1	0	12	6
Manure	0	15	2	2	0	2
Seed	0	10	6	1	11	6
Standing Charges	0	6	11	0	9	0
Labour—(a) Man	2	0	0	4	10	0
(b) Horse	0	15	0	2	2	0
Total Cost per Acre	6	3	2	12	13	8
Cost of Grain per Qr.	0	19	6	2	1	6
Cost of Straw per Ton	1	10	0	3	2	4

As each cow on the farms under investigation has consumed each year an average of 4 tons of roots and $1\frac{1}{2}$ tons of hay and straw, the cost of these home-grown foods, even when charged to the cows at the cost of production and not at market prices, has amounted to approximately £11 per cow, compared with an average of from £4 to £5 in pre-war days. This increased cost of

growing the home-grown foods fed to the cows has added an additional 2½d. or probably 3d. per gallon to the cost of milk production over and above the cost in pre-war days.

TABLE VIII.

*Influence of Cost of Home-Grown Foods on Cost of Milk Production.
Farm B.*

Amount per Cow per Year.	Cost per Cow per Year.	
	1913-14.	1919-20.
4 tons Roots	£ s. d. 2 10 0	£ s. d. 6 4 8
15 cwt. Hay	1 5 6	2 8 0
15 cwt. Straw	1 0 0	2 1 6
Cost per Cow per Year	4 15 6	10 14 2
Cost per Gallon of Milk	0 0 2	0 0 4½

3. **Purchased Foods.**—Perhaps one factor which more than any other has been responsible for the high prices of milk during the last few years has been the high prices charged for the purchased feeding stuffs.

When it is realised that on farm C. the average price per ton paid for

Linseed Cake	was	£8 5 0	in 1914	and	£25 5 6	in 1919
Cotton Cake	"	5 18 6	"	"	22 0 0	"
Coconut Cake	"	6 3 4	"	"	22 15 0	"
Soya Cake	"	7 6 0	"	"	24 18 3	"
Maize Germ Meal	"	7 19 0	"	"	24 0 0	"
Sharps	"	4 5 0	"	"	18 3 6	"

and that the purchased food-stuffs on that farm were bought at an average price of 1s. 5½d. per food unit in 1912 and 4s. 6d. per food unit in 1920, it can readily be seen what an important factor the high price of food-stuffs has been in increasing the cost of production of milk during the later years of the war.

On farm H. the yearly bill for purchased food-stuffs per cow in 1914 amounted to £14, 14s. 9d. and corresponded to 5½d. per gallon of milk produced.

The corresponding bill in 1919 was £40, 18s. 8d. per cow and corresponded to 1s. 3½d. per gallon of milk produced.

On farm P., a milk-producing farm of 106 acres in the industrial area of the West Riding of Yorkshire, the amount spent on purchased feeding stuffs for the cows during the year ending 31st March 1920 was £1785, 5s. 10d., corresponding to £15, 17s. 11d. per acre, £25, 14s. 9d. per cow per year, or 9s. 8d. per cow per week. On this farm the bill for the purchased food-stuffs was responsible

for more than a shilling a gallon of the cost of producing the milk and constituted more than 62 per cent. of the total cost.

An average cow will consume approximately one ton of cake or meal per year, corresponding to 6 lbs. per head per day throughout the whole year. The cost of that cake was roughly £15 per ton greater in 1919 than it was in 1914. Assuming the average yearly milk yield of the cows to be 600 gallons per head, the higher price paid for the concentrated foods in the year 1919 will have added an additional 6d. per gallon to the cost of producing milk.

It may be laid down as a general rule that each pound of cake the cow consumed per day last year added one penny per gallon to the cost of producing milk, over and above the cost in pre-war days.

(c) THE INCREASED DEPRECIATION OF COWS.

Another factor which of recent years has been largely responsible for the high price of milk is the difference between the buying-in price of a cow in milk and its selling-out price when dry. Before the war a man who bought his cows when newly calven and sold them out fat would rarely expect to drop more than from £3 to £5 at the most on the transaction. Of recent years he might easily have dropped from £20 to £30.

In 1913 the cows bought in on farm C. cost, on an average, £22; those sold out realised £18, 14s. per head, and the average loss on each renewal was £3, 6s. In 1919, on the same farm, the average price paid for each cow bought in was £60, 4s., and the average price realised by the sale of each cow passed out of the herd was £39, 10s. 10d., representing a loss of £20, 13s. 2d. on each cow replaced.

TABLE IX.

Influence of Depreciation of Cows on Cost of Milk Production.

Year ending March 31st.	Average Price paid for Cows bought in.	Average Price realised on Sale of Cows.	Average Difference between Buying-in and Selling-out Price.	Depreciation per gallon where Milk yield is 600 gallons per head and all Cows replaced Yearly.
	£ s. d.	£ s. d.	£ s. d.	
1913 ...	22 0 0	18 14 0	3 6 0	1'3 pence
1914 ...	24 13 0	19 0 8	5 12 4	2'2 "
1915 ...	32 0 0	19 9 10	12 10 2	5'0 "
1916 ...	33 10 0	20 7 2	13 2 10	5'2 "
1917 ...	35 0 0	27 15 10	7 4 2	2'9 "
1918 ...	51 10 4	37 13 0	13 17 4	5'5 "
1919 ...	60 4 0	39 10 10	20 13 2	8'3 "
1920 ...	56 16 8	40 15 5	16 1 3	6'4 "

The increased depreciation due to the inflated price of newly calven cows, in herds where the average milk yield is 600 gallons, and in which *all* cows are replaced yearly, is thus seen to add an additional cost of approximately 6 pence per gallon over and above

the cost in pre-war days. In herds where the cows are kept twice round and changed every other year, that additional cost has been 3 pence per gallon. In normal herds, where the cows are kept three times round and replaced every third year, the additional cost has been 2 pence per gallon.

All of the above—namely, the increased labour bill, the increased grazing bill, the increased food bill, and the increased difference between the buying-in price of newly calven cows and the selling-out price of these cows for beef—have been factors brought about largely by war conditions, and have been beyond the control of the farmer.

During the last few years, and especially since milk was decontrolled little more than a year ago, there has been a widespread feeling that milk producers were not justified in charging for their milk the prices which have been obtained. Had the public realised how the cost of producing milk had increased owing to war conditions, there is no doubt that the feeling would not have been so intense. Many of the letters of complaint which have appeared in the Press could have been written only in ignorance of the real state of affairs. Thus in one letter, out of which a milk profiteering case arose, the writer states "that while the farming industry is entitled to larger prices, in the case of milk the extra price should not be more than 50 per cent. on pre-war rates."

Actually, as can be seen from Table X., in those herds, where a ton of cake has been fed per head per year, where one-third of the cows are replaced in the herd each year, and where the average yearly milk yield is 600 gallons per head, the cost of milk production has increased by not 50, but approximately 300 per cent. since the outbreak of the war.

TABLE X.

Cost of Production of Milk per Gallon.

	Year ending 31st March 1920.		
	All Year round.	Summer Months.	Winter Months.
Original Cost per gallon in 1913-14.	5 pence.	4 pence.	6 pence.
Increased Cost of Labour	s. d. 0 4	s. d. 0 3	s. d. 0 5
" " Grazing	0 0 $\frac{3}{4}$	0 1 $\frac{1}{2}$	0 0
" " Home-grown Foods ...	0 2 $\frac{1}{2}$	0 1 $\frac{1}{2}$	0 4
" " Purchased ton Concentrated Food (1 ton per year)	0 6	0 3	0 9
Increased Depreciation in Herds where $\frac{1}{3}$ of Cows are replaced yearly ...	0 2	0 2	0 2
Total Cost 1919-20 in Herds where average Milk Yield was 600 gallons ...	1 8 $\frac{1}{2}$	1 3	2 2

Again, the statement is often made that up to quite recently the *rent* of the land on which the milk is produced has remained stationary since the war, and therefore it is argued the cost of producing milk cannot have increased much. In the letter already referred to the writer adds: "Of course it must be recognised that labour, machinery and imported food-stuffs cost more, but those items are not a large proportion of a farmer's total expenses. One of the largest items of expenditure is the *rent*, and this, again, is the same as it was before the war."

In the herds which were costed last year each cow, on the average, had the run of

	1.5 acres of grass
and consumed the produce of	{ 0.4 ,, hay
	{ 0.3 ,, straw
	{ 0.2 ,, roots

and the *rent* of the 2.4 acres given up to each cow amounted to £3, 10s. 5d. per year. If to this we add 10s. for the rent of each stall in the byre the total rent bill amounted to approximately £4 per cow. As the average cost of upkeep per cow amounted to £52 per year it will be seen that the rent was responsible for less than 8 per cent. of the total cost of keeping a cow, whereas the total labour bill is responsible for approximately 25 per cent. and the bill for purchased foods for more than 40 per cent. of the total cost.

Fortunately during the last year prices have eased considerably and the cost of milk production during the year 1920-1921 was, as can be seen from Diagrams 1 and 2, in practically every case considerably lower than in the previous year, and shows every sign of being still lower in the current year.

Thus of the more commonly used fertilisers sulphate of ammonia was quoted in July 1921 at £13, 16s. per ton as compared with £23, 10s. per ton in July 1920; basic slag, 20 to 22 per cent., £3, 16s. per ton in 1921, £5, 7s. per ton in 1920; steamed bone flour £9, 10s. per ton in 1921, £16 per ton in 1920; nitrate of soda £17 per ton in 1921, £24, 5s. per ton in 1920.

The falling prices of seeds and fertilisers are both helping to reduce the costs of grazing and of producing the home-grown foods.

The prices of purchased concentrated foods have fallen, if not to their pre-war level, at least 30 or 40 per cent. Thus linseed cake in January 1920 was quoted at £25 per ton, in July 1920 at £20, 10s., in January 1921 at £18 per ton, in May 1921 at £14, 10s.; since then there has been a slight hardening of prices, English-made linseed cake in July 1921 ranging from £15, 5s. to £16, 10s. per ton. On farm C. food-stuffs were bought in 1920-1921 at an average rate of 3s. 6d. per food unit as compared with 4s. 6d. in 1919-1920.

The cost of labour, though still at least three times and in some cases four times as high as in pre-war days, has apparently reached its high-water level and the probability is that wages will in the future fall rather than rise.

BORDER LEICESTER SHEEP.

JAMES WOOD, O.B.E., M.A., B.Sc.

Origin and Early History.—This is one of the breeds of British live stock about whose origin there is no doubt. They are lineal descendants of the Dishley Leicesters made famous by the work of Robert Bakewell (1726-1795) of Dishley, Leicestershire, the man to whom more than to anyone else Britons owe the proud position of supremacy in the live-stock world which they occupy to-day. Although it is so well known to all breeders of the present day, yet it was not until the latter half of the eighteenth century that it was discovered that it was an unsound policy to send to the butcher the animals that matured quickly and to retain for breeding only those which were of slower maturity. It was Bakewell who made this apparently simple discovery, and he set to work vigorously to put his theory to the practical test, with results that have had extraordinary effects on the live-stock economy of the British Isles.

But it is a far cry from Leicestershire to the border counties between England and Scotland and the connection must be established. Bakewell's fame as an improver of stock spread to such an extent that Dishley was visited by many enthusiastic home breeders as well as by representatives of foreign countries.

Among his early visitors were two pairs of brothers who have left their mark on the live-stock industry of this country. Charles and Robert Colling, who were farming near Darlington, in the county of Durham, brought home with them specimens of the improved Dishley Leicesters, and they might easily have acquired fame for their work among sheep had that not been hopelessly eclipsed by their work among cattle. Observing the success which followed their experiments in sheep-breeding, they at once decided to apply Bakewell's methods on the substantial, big-framed cattle which were to be found in their own immediate neighbourhood, and thus they became the founders of the Short-horn breed. The other pair of brothers were Matthew and George Culley, who, after being pupils with Bakewell, commenced farming in Northumberland in 1767. Naturally they brought to their northern home some of the Dishley Leicesters, and their example was soon followed by several leading farmers on both sides of the border. When these men wanted fresh blood they invariably had recourse to Dishley. When Bakewell died in 1795 a number of his neighbours formed themselves into the Bakewell Club and bought up the Dishley sheep, with the object of maintaining their purity. From members of this club the northern breeders continued for many years either to purchase or to hire rams, the price paid for the hire of a ram for the season varying from 50 to 200 guineas.

In these days of high prices it may be of interest to note some of the prices paid a hundred to a hundred and fifty years ago, authentic records of which are still available. Culley in his book on *Live Stock* mentions that in one year Bakewell took in for service by one ram forty ewes from each of two breeders at a fee

of 10 guineas per ewe, and that in addition he gave the ram forty of his own ewes. The list of prices obtained at Robert Colling's dispersion sale of Leicesters at Barmpton, Darlington, in 1818 is still preserved, and it shows that thirteen shearling rams realised prices varying from 13 to 156 guineas, with an average of 40 guineas, and that 105 ewes were sold at prices varying from 20 to 61 guineas for pens of five.

Soon after the Culleys introduced Leicesters into Northumberland they began to hold an annual sale at which they disposed of both rams and ewes. The result was that there were soon established both in Northumberland and in the south-eastern counties of Scotland a number of small flocks of pure Leicester sheep. Evidence of this is to be found in the *Statistical Account of Scotland*, compiled by Sir John Sinclair in 1792-1793, in which there are frequent references to the "Bakewell" breed of sheep. In the description of the live stock in the parish of Ladykirk, Berwickshire, the writer says:

"The sheep in general are very good and are of the kind commonly known by the name of the new 'Leicestershire' breed which were first introduced by Mr Bakewell. This breed of sheep are uncommonly good feeders, but often do not carry so much tallow as many other kinds do in proportion to their weight. Mr Culley has undoubtedly the merit of having first introduced this breed of sheep into the country some twenty years ago, and at present there are eight or nine people in the district between the Cheviot and Lammermoor Hills whose sheep flock are very highly improved. The sheep formerly in this county, called 'Muggs,' were a tender, slow-feeding animal, with wool over most of their faces. There is hardly an individual of this species now to be met with in the neighbourhood. Mr Culley's kind of sheep, on the other hand, have open countenances, without any wool on the face from the ears forward, and are as kindly feeders as the others are slow ones. They are neither long-bodied nor long-legged, but well-made, handsome sheep, deep in their chest, broad at their shoulders, loins and crops, which last are thrown well back; and they are deep and broad of their breasts, which are well seen before; they stand on well-proportioned, clean, small-boned legs. Mr Culley's flock is almost entirely sprung from Mr Bakewell's, as he wisely perceived that Mr Bakewell was in the right tract of breeding long before most people would allow it."

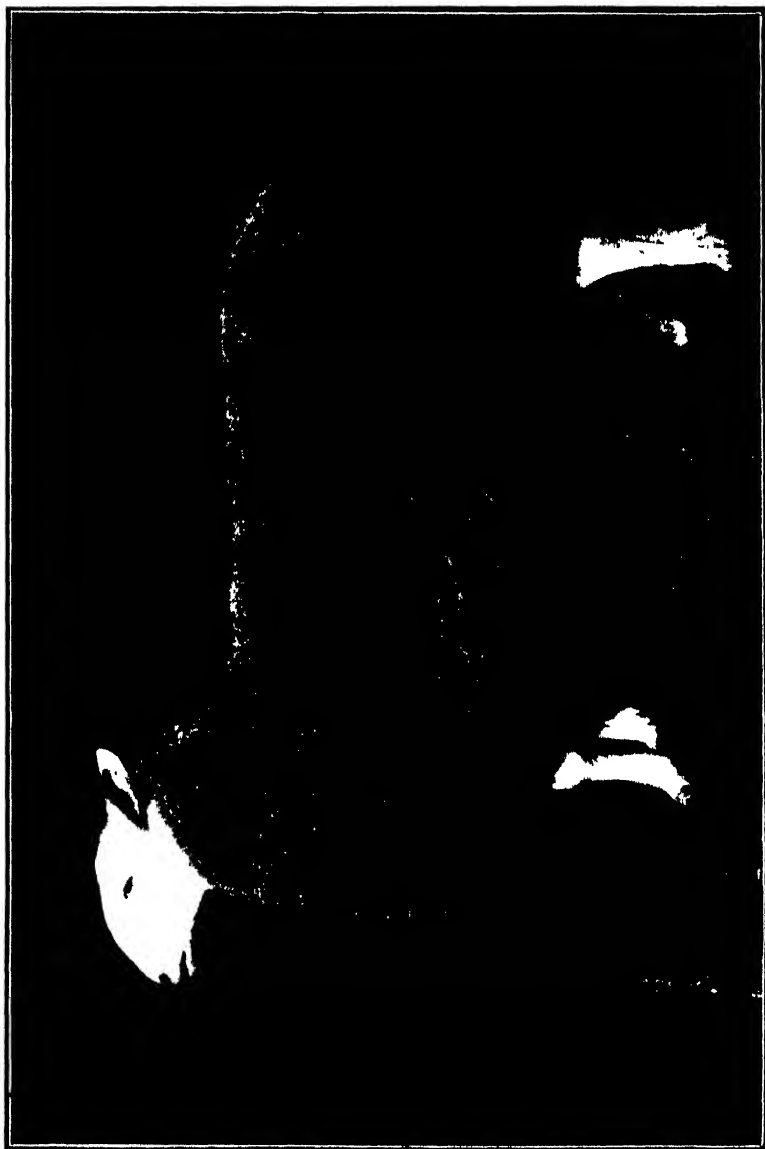
Of the sheep in the parish of Bunkle and Preston in the same county it is said:

"Sheep is the great staple of the low parts of this parish and of this country in general. They are the English breed introduced by Mr Bakewell and since carried on by the Messrs Culley and other eminent breeders both in Northumberland and this county. The criterion of their goodness and



Two-Shear Ram, DAUNILESS (L 600).

Champion of the Breed at the Highland Show, Aberdeen, 1920



Shearling Ram, MARCUS ECLIPSE.

Sold at Kelso Ram Sale, September 1929, for £1,100



Ewe.

Champion Female as a Crimmer at the Highland Show, Hawick, 1914.



Shearling Ewe.

Champion of the Breed at the Royal Show, Manchester, 1910

sort is getting sooner and more easily fat than any other animal, bearing a valuable fleece and enriching the land upon which they are fed. High prices are paid for the hire of rams of good breeds—viz. from 10 to 30 guineas is common per season. Some have paid double and more for the season of the best bred rams. Our farmers pay as much attention to the breed of their sheep as is paid to the highest breed of galloping horses in England, and I believe they bring much greater profit."

As showing the extent to which the breed was making its influence felt even in those early days, mention is made of them being maintained in all the southern counties of Scotland, as far north as Perth, Forfar and Moray, and even as far west as Inveraray in Argyll.

Development.—Consideration of the high prices paid for rams raises the question as to what object the northern breeders had in view when they paid these prices. Was it for the purpose of breeding pure Leicesters or for crossing with some other breed? The quotations given above tend to show that the native sheep—the "muggs"—were gradually being replaced by the new breed: there is no mention of them being improved by crossing with the Leicesters. Let us look at the record of an individual flock, which is probably typical of most—the flock originally established by Thompson at Bogend about 1795, removed by his descendants to Mungo's Walls, Duns, about 1833, and finally dispersed in 1903. The foundation of this flock was laid by the purchase of gimmers from breeders of Dishley sheep, and for some years rams were hired from Culley and other northern breeders. Later on rams were hired from a member of the Bakewell Club for a period of twenty-five years, and for a further period of ten or twelve years from another member of the same club. Clearly Thompson was breeding pure-bred sheep. Other instances might be given, but sufficient has been said to warrant the conclusion that the border men were paying for rams to breed pure-bred and not cross-bred sheep.

The practice of using rams bred in the south was fairly common up to about 1830, but onwards from that date it was gradually discontinued, until it was altogether abandoned about the middle of the century. The southern ram was no longer required because the northern breeders had gradually evolved a type of sheep which was very different from that which found favour in the south. This was not to be wondered at when we consider the different conditions of soil and climate, the different systems of feeding, and, above all, the different inclinations of individual breeders. The northern type had become longer in the body, better sprung in the rib, more developed in the brisket, more graceful in the set of the neck and head, and altogether a gayer sheep than the southern. The existence of this difference gave rise to much jealousy, especially at the show-yard meetings of the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland. The question as to which was the true representative of Bakewell's Leicesters was freely discussed but never settled, but there can be no doubt that the two types can claim a

common origin and that the differences are due to natural causes and not to the admixture of extraneous blood, as has been frequently alleged but never supported by any reliable evidence. The show-yard friction grew, however, and the northern breeders began to call their sheep Border Leicesters, and after a considerable amount of agitation succeeded in inducing the Highland and Agricultural Society to provide separate classes for the two types. The records of the Society show that classes were provided for Leicesters only up to the year 1868, for both sections from 1869 to 1872, for Border Leicesters only in 1873 and 1874, for both sections from 1875 to 1881, and since that date for Border Leicesters only.

Description.—Perhaps the best description of the appearance and general characteristics of the breed, so far as these can be set down on paper, can most easily be derived from a detailed account of the points of a shearling ram as he would appear in the show-yard or sale ring at sixteen to eighteen months old. It has to be remembered that the breed exists for the purpose of producing a good carcase of mutton at an early age, and to the critical it may seem that some of the points mentioned have little connection with the production of mutton. But in dealing with pedigree stock breed characteristics cannot be entirely ignored, and the criticism referred to will apply only when show-yard fancies are allowed to supersede the outstanding points of commercial utility which the breed possesses in such a marked degree.

The shearling ram at the age stated will stand about 32 inches at the shoulder and will measure about 40 inches from the crown of the head to the tail. He has a wide, level back, well and evenly covered with mutton that is firm under the hand. His well-sprung rib gives him the width of back that is so desirable, and it also enables him to carry his stomach high so that his underline is almost as straight as his back. The head is all-important—every detail indicates the presence or absence of the robustness of constitution and the aptitude to grow and mature rapidly, which are necessary attributes of any meat-producing animal. Too strong a head is an indication of coarseness, as too weak a head is of delicacy. It should, however, be thoroughly masculine, with slightly aquiline nose and well-developed muzzle. The nostrils should be wide and dark. White or pink noses occasionally appear, but as they denote a weak constitution they are looked upon with disfavour. The eye should be clear and bold, the crown smooth and devoid of wool, the ears evenly set on, neither drooping nor too much cocked, and neither too thin nor too fleshy. The skin of the head should be of a pale pink colour and well covered with pure white hair. Black spots will occasionally appear on the head and ears, but while not regarded as a serious blemish they are not favoured by breeders. The neck tapering nicely from the head should be strongly set in at the shoulders—there must be no slackness at the junction. The neck vein should be well developed and the brisket brought well forward. The shoulders should slope gently to the ribs and thus avoid narrowness at the heart. The loin should be wide and firm, and the quarters long and deep, the gigot filling the hand well. The legs must be squarely set under

the body, strong, with clean, flat bones covered with perfectly white hair and quite free from wool. The whole body, above and below, should be evenly covered with white wool of equal quality throughout and comparatively fine staple—curly, but not open to the skin. If the ram has all these desirable characteristics he will be evenly and symmetrically balanced and will be able to move freely and carry himself with a gaiety that is equalled by few of his species.

The above description may be applied equally to a shearling ewe or gimmer, making due allowances for the difference in sex. She is, of course, sweeter and milder in countenance and less strongly built than the ram, but she must not lack that size and substance which are inseparable from a sound and robust constitution.

Distribution.—The quotations given above from *The Statistical Account of Scotland* of 1792-1793 show that even at that early date the breed had taken a firm hold on the south of Scotland, and that it had adherents in the Midlands and north of Scotland also. To-day it can safely be said that the only districts in Scotland in which pure-bred flocks are not reared are those comprising the Western Highlands, while in all but the most exposed parts of those districts rams of the breed are used for crossing purposes. In England the breed is strongly represented in Northumberland and Cumberland, and to a less extent in Durham, Yorkshire and Westmorland, while a few isolated flocks are maintained even farther south. In Ireland they have advanced rapidly in favour during the past twenty years, and although the flocks in that country are not large, yet the number of registered flocks has now reached 118. In regard to countries outside the British Isles, New Zealand maintains more Border Leicesters than does any other country, but exports are annually made to several European countries, to Australia, Canada, South Africa and South America, while by reason of a recent important purchase Japan must now be added to the list of importing countries. This wide distribution both at home and abroad tends to show that no other breed can adapt itself to great variations of soil and climate more successfully or more rapidly than the Border Leicester. So long as they are not grazed too closely, and provided that the land is naturally dry, they can be bred and they will thrive on land of medium quality, even though the situation is high and exposed.

Commercial Value.—The mature Border Leicester yields a carcase of dressed mutton weighing from 100 to 120 lbs., and a fleece of wool weighing from 8 to 12 lbs., depending on the nature of the land on which he is reared. It cannot be claimed that either the mutton or the wool is of first-rate quality, and if breeders had to rely on the return they get from their sheep by reason of their production of mutton and wool, it may safely be stated that there would be fewer flocks of Border Leicesters maintained in the country. The chief object which breeders keep in view is undoubtedly the production of rams. At the annual sales usually held in the month of September there are between 6000 and 7000

shearling rams sold. The most important of these sales is that conducted by the Border Union Agricultural Society and held annually at Kelso on the second Friday in September. Here all the best specimens of the breed are disposed of, and consequently it is at Kelso that breeders in search of stud rams congregate. Other centres at which large numbers of rams are sold are Edinburgh, Perth, Aberdeen, Glasgow, Ayr, Carlisle and Rothbury. It may be stated without hesitation that not more than ten per cent. of the rams sold are used as stud rams in pure-bred flocks, and it therefore follows that the other ninety per cent. are mated with ewes of other breeds for the production of cross-bred lambs. In fact it is to the Border Leicester ram's pre-eminence as the sire of quickly growing, rapidly maturing cross-bred lambs that the breed has maintained its great popularity for over a century.

Of all the crosses of which the Border Leicester ram is the sire, by far the most important in point of number and of commercial utility is the "Half-bred"—the cross between the Border Leicester ram and the Cheviot ewe.

In *The New Statistical Review of Scotland* published in 1845 frequent references are made to the production of this cross not only as a butcher's animal, but for retention for breeding purposes. So that as far back as the middle of the nineteenth century the half-bred had begun to lay the foundation of the prosperity which it has brought to the sheep farmers on both sides of the Scottish border. It has attained so much importance that for many years past separate classes have been provided for the breed at the Highland and other leading shows in south-eastern Scotland and north-eastern England. In these districts the half-bred ewe is the commercial breeding ewe on all the lowland arable farms, and the value represented by such stocks must reach a very considerable sum of money. They are bred on high-lying farms where Cheviot ewes are maintained, the general practice being to cross the Cheviot ewes with the Border Leicester ram after she has reared two or three crops of Cheviot lambs. The half-bred wedder lambs are fed off on turnips at eight to ten months old, while the ewe lambs are sold at such centres as St Boswells, Kelso, Duns, Peebles and Reston, where they are bought to replenish breeding flocks of half-bred ewes. It should be stated that the half-bred ewes are most excellent nurses and very prolific breeders, for with ordinary care in management they will generally rear 175 per cent. of lambs.

Another cross, second in importance only to the half-bred, is that obtained from the blackface ewe and known as the greyface or mule, this latter term being used in some parts of the north of England. They are bred in very large numbers in the north of Scotland and in the more exposed parts in the south where blackface ewes are kept rather than Cheviot. They are also very popular in the north of England where the ewe lamb is retained for breeding purposes in the same way as the half-bred is retained in Scotland. Naturally the greyface is not so large as the half-bred, but their mutton is of excellent quality.

The Border Leicester-Suffolk cross has produced many outstanding pens of fat lambs which have been exhibited at the

Scottish National Fat Stock Show. The representatives of this cross are almost invariably in the short leet for the championship of the sheep section and on several occasions have secured the final award.

Recently a breeder of Dorset horn sheep has experimented in the production of early fat lambs by crossing his ewes with a Border Leicester ram. This has been so successful that the breeder has gone beyond the experimental stage and proposes to make it part of his ordinary practice in future.

In Australia, Lincoln, Leicester and Border Leicester rams are largely used for crossing with Merino ewes, and in 1909-1910 the Department of Agriculture for New South Wales instituted a series of experiments with the object of ascertaining the relative merits of these British breeds for the production of cross-bred sheep combining wool and mutton values under different conditions of climate and rainfall. The results of these experiments are set out in full detail in *Farmers' Bulletin* No. 132, written by the Department's Sheep and Wool Expert and published in August 1920. The conclusions arrived at were that "the Border Leicester crosses furnished the most suitable class of carcase for export," yielding "relatively a greater proportion of dressed mutton to the total live weight than either of the other two crosses."

In regard to wool, the Lincoln crosses yielded the heaviest fleeces, but the Border Leicester cross wool, owing to its finer and more uniform quality, brought the highest price per pound, and the average value per fleece was within a fraction of a penny of that of the Lincoln cross fleece. This indicates that in Australia and other countries where Merino flocks are maintained the Border Leicester takes the lead as a crossing sire.

From the description given of a Border Leicester ram, it may be gathered what are the characteristics which make him so valuable as a crossing sire. Firstly, being a thick-fleshed and rapidly maturing sheep, when he is crossed with thin-fleshed and slow-feeding ewes the offspring is a quickly maturing sheep with better quality of mutton than the sire and a greater quantity of it than the dam. Secondly, being active, high-spirited and of sound constitution, he is able to follow the ewes on the steep, exposed hill-sides on which so many flocks are pastured during the early winter months. Thirdly, although he has a heavy carcase of mutton he carries it on fine bones, and hence when he is crossed with smaller ewes there is less risk of loss during parturition than is likely to result if strong-boned, coarse-headed rams are used. These facts justify the claim that the Border Leicester, of all British breeds of sheep, is the most valuable for crossing purposes.

In 1898 the breeders formed themselves into "The Society of Border Leicester Sheep Breeders." The Society gives valuable prizes and medals at all the leading shows, and issues a *Flock Book* annually in which both rams and ewes are registered individually, and also each flock has its own registered number. The first volume of the *Flock Book*, issued in 1899, contained 165 members and 160 registered flocks. Volume xxiii., issued in 1921, shows that the membership is now 470 and the number of registered flocks is 460.

ECHTHYMA OF THE SHEEP.¹

J. P. M'GOWAN, M.A., M.D.

THIS disease, which is sometimes known as "black-pox," would appear to have been very infrequently observed by farmers and shepherds in this country. The malady, however, when it does occur, and when it is not dealt with properly, is a very destructive one to both ewe and lamb: on the other hand, where it is recognised and treated properly, it is extremely easy to control. For these reasons it was thought that a description of the disease would not be out of place in this journal, more especially as the writer has been able to observe closely two well-marked outbreaks during this spring. The history of these two outbreaks will serve as an introduction to the subject.

In the first outbreak, the disease commenced in an Oxford-cross ewe which lambed in March. The lambing shepherd, who had charge of this ewe, had noticed that she had a bad teat; but, as he had no previous experience of the disease, he did not attach any special significance to the occurrence. Owing, however, to the lamb being able to suck only indifferently, it was badly nursed and the shepherd proceeded to give it cow's milk from a bottle with a rubber teat. The gimmers now began to lamb. Sheep of this age have usually a poor supply of milk for the first few days after lambing and some of their lambs had to get extra food in the shape of cow's milk. For this purpose the same bottle was used as was being used for the diseased lamb above mentioned. The result was that all these lambs became affected with the disease in their mouths and in turn communicated the disease to their mothers. One lamb, however, which along with its mother was grouped in the lot last described, for some reason was not bottle-fed, and both it and its mother, although closely associated otherwise with the diseased lambs, escaped infection. After the disease had become firmly established the head shepherd, who had previous experience of the disease and knew its gravity, became aware of its existence and took measures to check its further spread. The most important of these was the use of separate bottles for feeding purposes for the sick and the healthy lambs. The spread of the disease was at once checked. Before, however, this had taken place, more than a score of ewes and their lambs had become affected.

Besides the important part played by a lack of knowledge of the disease in favouring its spread, as instanced in this outbreak, another factor in the occurrence of the disease is well exemplified. For some reason it began in an Oxford-cross ewe, but its ravages were most felt among the gimmers and their lambs. This is to be attributed to several reasons. Apart from the more or less accidental use of the bottle for feeding, necessitated, however, by the fact of the lambs' mothers being gimmers, it is to be noted that gimmers and their progeny are very susceptible to the disease where it occurs at all. Their lambs are always hungry, owing to

¹ Probably the disease known in German as "Maulgrind" or "Schwarzes Maul," and in French as "Bouquet" or "Noir Museau."

lack of milk, and are therefore constantly attempting to suck their mothers. The mothers' teats in consequence are always in a moist condition from the saliva of the lambs, time never being allowed them to dry thoroughly. This, along with frost at night, will cause, and does cause, them to "hack" badly. Apart from this, however, the lamb, in its attempt to obtain milk where there is very little, sucks strenuously and in doing so bites the teats. Add to this the fact that the teats of a gimmer are in a soft condition and unhardened by a previous nursing,¹ and the very best conditions are present for the production of "hacks." It is true that many sheep have hacked teats and do not develop the disease, but given the presence in the flock of an infectious disease of the above nature, these "hacks" are the very best *nidus* for its settling down.

In the second outbreak the disease had been going on for about three weeks before I was asked to see it. Here, as before, the infected animals were practically all gimmers with their lambs, and, as before, the lambs had been fed on cow's milk from a bottle, the disease having, doubtless, been spread by this means. It could not be ascertained with what age of sheep the disease had commenced.

In all about thirty ewes and their lambs were the subject of the disease. These were kept in one flock by themselves and their appearance was eloquent testimony to the gravity of the condition. In this case also the shepherd in charge had no previous experience of the disease and could not be expected to know how to deal with it. As instancing the ease, however, with which the disease may be controlled, a shepherd on a neighbouring farm who was acquainted with it had two separate occurrences of the disease in his flock. He prevented it spreading further by isolating the invalids, taking precautions with regard to bottle-feeding and by stopping box-feeding. The significance of this last precaution will be discussed later.

Some general facts in connection with the disease may now be dealt with. With regard to the udder of the ewe, the disease usually starts at the base of the teat, in the form of a rounded, hardened lump felt as such deeply beneath the skin. This breaks down and points at the surface through a thin, hardened, horny layer of skin. The pustule or abscess then bursts and becomes a large fungating ulcer which, no doubt due to the irritation of the lamb suckling, spreads down and round the teat until in the end there results a greatly thickened, indurated teat which is ulcerated all over its surface. The teat has now become fleshy-coloured and black, from which appearance the name "black-pox" is derived. Very frequently the procedure (unwise on every possible ground) is adopted of attempting to draw milk by the hand from the teat in this condition, with the result that the whole granulomatous

¹ It has been a custom in some places to take a lamb from the hogs. The ewe hogg has usually only one lamb, whereas a gimmer has more commonly two. Consequently the ewe hoggs' teats will be much less damaged in the suckling process. At the same time their teats will be hardened for the next year's lactation, and "hacking" has been found to be much less prevalent under such circumstances.

mass is stripped off, leaving only the core of the teat, consisting practically of only the milk duct.

In the course of the spread of the inflammation the milk duct becomes closed, with the result that the milk dams back in the udder on that side, which becomes very much swollen and hard. But even although the milk duct is not blocked, the milk cannot be pressed out by hand or by the sucking of the lamb owing to the induration and lack of elasticity of the teat.

One or both teats may be affected, according to the gravity of the disease. In most cases under observation only one side was affected, and the lamb continued to suck the unaffected side, with bad results to itself and its mother, as will be pointed out later. In many cases the ulcers spread on to the surface of the udder and because of attrition also on to the inner sides of the thighs and legs. I did not observe them anywhere else on the old sheep, except in one case, where they were on her mouth and nose. This had been brought about by her biting her teats and rubbing them with her mouth. In many cases the general health of the ewes was affected by the disease. They went off their food and their bellies "went off" them. The disease, however, is not such as to kill the ewe of itself. It is the complications that follow in its wake that make the disease such an important one economically. Thus a very large proportion of the ewes die from udder clap or garget, directly attributable to the disease. Those that do live are rendered useless for breeding purposes, because the udder in whole or in part is destroyed. Such ewes have therefore to be cast, a very important consideration inasmuch as gimmers are almost always the victims.

So much for the disease in the ewes. We now come to a consideration of the condition in the lambs. An interesting point in this connection is with regard to one of the ways in which the shepherd may first become aware of the existence of the disease in his flock. He may never have noticed anything wrong with the teats of any of his ewes, when all at once he may observe that his "pet" or motherless lambs, which are being brought up with cow's milk from a bottle, are suffering from sores in their mouths and on their faces. To one who knows the disease the explanation is evident. The bottle which is being used to feed the pet lambs is also being used to feed some lamb in the general flock which, along with its mother, has the disease, and of whose existence up to that time the shepherd has been unaware. Such an occurrence should direct attention at once to all the other ewes and lambs in the flock.

In the lamb the disease is characterised by the appearance of vesicles and pustules, which later become ulcers in the mouth and all over the lips and face. The lower jaw is particularly swollen and overshot; the mouth is greatly inflamed and ulcerated; the breath is foetid; the teeth are loose and fall out; the nose is blocked by the ulceration spreading up the nostrils, causing thereby stertorous breathing and the lamb to lose hold of the teat and gasp for breath at intervals when sucking. The ulcers may spread up the sides of the face on to the ears, and in many cases they attack the eyes, causing disintegration thereof and blindness.

The ulcers are often of large size—size of a shilling—on the face of the lamb, and either raw and bleeding or, in the earlier stages, covered with the partially destroyed skin. Such ulcers are grey in colour and superficially indented with slight hollows and resemble somewhat cow-pox lesions at their mature stage. This covering is easily removed, exposing abundant pus of a mucoid or ropy nature; and when this is wiped away the raw inflamed granulosomatous surface of the ulcer is exposed. The margins of the ulcer are raised and inflamed.

The mortality directly from the disease is not high in lambs. A certain number, however, die from a septic pneumonia induced by the conditions in the mouth and nose. Owing to the lack of milk and the disease the lambs are very much retarded in growth.

The question may now be discussed whether the disease arose in the ewe or the lamb. Everything points to its beginning in the ewe. In the case of a ewe which afterwards developed the disease the teat has actually been observed to be swollen and indurated before the lamb showed any symptoms. Apart from this, the sporadic nature of the disease and the absence of spread from lamb to lamb directly point in the same direction. Again, the full-grown sheep is more likely to harbour the disease germ and pass it on to the lamb than is the lamb to originate it and pass it back to its mother. In this connection it should be borne in mind also that, with the teeth just sprouting, the mouth of the lamb is very vulnerable towards any infection derivable from the teats of the mother.

The next question in this connection is, How is the disease carried on in the flock, in the sheep or elsewhere in the interval between the various outbreaks? Thus, for instance, the shepherd in the first outbreak recorded above informed me that he had had the disease very badly on the farm on two previous occasions without the occurrence of a single case, so far as he was aware, in the intervals. The outbreak previous to the present one occurred more than ten years ago, and the question arises as to how the Oxford-cross ewe responsible for the present outbreak contracted the disease. It may be that the chapter of accidents responsible for the bringing of the disease to noticeable proportions was absent in other years—such as, for instance, the bottle-feeding of the lambs and the box-feeding of the ewes. It might be that the disease had been introduced by newly bought-in sheep, but the ewe in which the disease commenced had been on the farm for at least three years and had had healthy lambs previously on the farm. All the ewes which were lambing this year had been on the farm for at least a year and a half.

Some light may be thrown on this aspect of the subject by a consideration of the disease as it occurs in children in the form of Echthyma or its milder form, Impetigo Contagiosa. It is a well-known fact that in a large percentage of children suffering from these diseases the origin has been a prick with a thorn or a scratch with a nail on the finger. Thereafter the disease is spread to the face by the child rubbing or scratching its face with the injured finger, which has begun to fester meantime. In a large number of these cases no history of contact with a case of the disease can be

elicited, and it is believed by authorities on skin diseases that no such contact is necessary, and this in spite of the fact that the skin specialist is well aware of the extremely contagious nature of the disease once it has started. There is therefore here a loss of continuity between one case and the next, as in the ewe condition. There is, however, in the case of the ewe a condition of the teat which might well bridge the gap. One often sees on the teats of old ewes in flocks unaffected with the disease pocks indistinguishable, except in regard to their size, from those giving rise to the disease. These pocks, however, are not burst as one sees them, and perhaps the important factor in the genesis of the disease in the individual sheep is the set of circumstances alluded to above which results in the bursting of the pock by the biting of the lamb.

The bacteriology of the disease may be discussed with advantage in conjunction with the two diseases mentioned above as occurring in children—namely, *Echthyma* and *Impetigo Contagiosa*.¹ *Impetigo Contagiosa* is the milder of the two conditions, often, however, being transformed in the case of debilitated children into the graver condition, *Echthyma*. The sores can be inoculated from one part of the body to another by slight injuries, such as by scratching, this being a common method for soldiers who had contracted the disease prolonging their stay in hospital wards during the war. *Echthyma* in children, where the disease can be observed in its very earliest stage—that of a clear bleb—has been proved to be caused by a streptococcus. This is in consonance with a more or less general rule that bleb formation in skin conditions is generally associated with the streptococcus as a causal factor. When, however, the bleb, which lasts only a short time, gives place to pus formation and ulceration, contaminating organisms such as staphylococci from the hair follicles, mucus and sweat glands invade the lesions and confuse the issue. These latter organisms have been obtained from the lesions by some investigators and have been considered by them to be the actual cause of the disease. There would appear to be no doubt, however, that they are nothing more than contaminations, which do undoubtedly aggravate the condition. With this premise it may now be stated that in my investigation into the disease I was unfortunately unable to obtain the lesions except in their later stages. Any cultures I made from them gave pure cultures of a staphylococcus which I considered from the evidence available in the human condition unlikely to be causal and which, therefore, I did not proceed to test out, more especially as circumstances were not opportune for animal experimentation (on lambs). Fortunately, however, so far as dealing with the disease is concerned, this was no great omission, the establishment of the actual causal organism, as will be seen, being more or less only of academic interest.

The question of the factors governing the spread of the disease in a flock, once it has arisen there, may now be discussed. An

¹ Though no suggestion is made that the disease in sheep is the same as that in children, it is of interest to note that the little girl of one of the shepherds, who was in the habit of feeding the pet lambs affected with the disease developed a typical lesion on her mouth through putting the teat of the bottle with which she fed the lambs into her mouth.

important point to be noted in this connection is that the disease in its "epidemic" form is not known among hill stocks, the place of its occurrence being among the flocks on the low grounds. When we consider the causes leading to the spread of the disease in such flocks, the reasons for the absence of the disease among hill stocks will be evident, though circumstances could easily be imagined where it could spread even in hill stocks. Briefly put, the causes of the spread of the disease on low-ground farms are the non-recognition of first cases by the shepherd, bottle-feeding of gimmer lambs—which, being hungry and badly nursed, bite their mothers' teats—and box-feeding. As the import of this last cause has not been discussed, its bearing on the question may now be pointed out. When box-feeding is being carried on, the ewes feeding at the troughs have no attention to give to what lambs are sucking them. Ordinarily they would resent any but their own lambs doing so. The diseased lambs, driven by hunger, seize this opportunity and suck whatever ewes they get the chance to. The teats of healthy ewes become infected thus, their own lambs subsequently develop sore mouths and in turn become "robbers," thus further spreading the disease. From this short discussion of the causes giving rise to the spread of the disease on low-ground farms it will be seen at once why it does not spread on hill farms. In these situations the feeding of the gimmers' lambs with cow's milk is rare and box-feeding is not resorted to.

As regards the discussion of this disease by previous writers on the subject of sheep diseases there would appear to be considerable confusion. Under such terms as Aphtha, Ulcerative Stomatitis, etc., the disease would appear to have been partly described by several authors, but none of them, with one exception to be mentioned later, make any statement regarding the important point of the occurrence of the disease on the udders of the ewes. Thus Youatt (1), p. 413, describes what might be the disease under the heading of Aphtha or Thrush, and at the end of his description refers to another disease of a similar nature as occurring on the Continent under the name of "Black Muzzle." There is no reference, however, to the disease as occurring on the udders of the ewes. Again, Bénion (2), p. 502, refers to a disease bearing such names as Bouquet, Noir Museau, Faux Museau, Poutère, Barbouquet, Bouquin, Bique, as occurring on the face and lips of sheep. He makes no reference, however, to the disease as occurring on the udders. Bigoteau and Bissauge (3), p. 76, apparently refer to the disease under the name of Ulcerative Stomatitis. They state that the disease is often called Thrush, on analogy of this disease to Thrush in children, but deprecate such a use because the causative organism of Thrush in children, the specific yeast, has not been found in this condition. Here, again, there is no reference to the disease on the udders. In German literature one finds what is in all probability the same disease described by Mai (6) under a large number of names, such as Maulgrind, Crusta Serpiginosa, Crusta Labialis, Impetigo Labialis, Lämmergrind, Teigmal, Teigmaul, Maulraude, Maulschwamm, Fasch, Schwarzes Maul. There is no reference, however, to the disease occurring on the udders.

Professor Axe, who is responsible for several of the notices on sheep diseases in (5) Wrightson's *Sheep, Breeds and Management*, describes there at p. 223 a disease, Aphthæ or Thrush, as occurring in lambs, which disease would appear to be identical with the one now under discussion. He points out that the presence of this disorder in lambs rarely or ever exists alone, but is mostly attended with a form of inflammation of the udder of the dam, which, on account of its destructive effects on the gland, has been designated malignant or gangrenous mammitis. He states that with regard to the immediate cause of the disease little is really known, and suggests that it may be dietetic in origin. In his experience the lambs have invariably given evidence of the disease first, and afterwards the ewes have appeared to become inoculated from the mouths of their young. With regard to the source from which the lambs received the infection he states that this is a question still waiting solution. (This view has been discussed previously (*vide supra*) and a different conclusion arrived at.) He further states that young lambs from two to six weeks old are mostly its victims, but that older sheep are sometimes seriously affected. It rarely, however, prevails in stock over two years old. As a rule, he adds, the fatality arising from this disease is very considerable in sucking lambs and he has known it on more than one occasion to sweep off a large proportion of a promising flock. The disorder prevailed to some extent in the ewe flocks of Lincolnshire during 1889 and proved very fatal to both lambs and ewes.

With regard to the treatment, he remarks that nothing in the whole range of veterinary practice is so difficult as to prescribe for the successful treatment of cases of this description. He recommends isolation of the sick and that the shepherd should have no communication with them until they are again convalescent. He also suggests an entire change of food. He avers that the affected lambs may be allowed to continue to suck the ewes so long as their udders remain free from the disease, but as soon as the eruption presents itself on the latter they should be taken away and fed with the bottle, while at the same time the ewes are carefully hand milked until the gland is restored to a normal condition. (This procedure, according to the view to be expressed in this paper, is very bad practice and can end only in making matters worse for both ewe and lamb—*vide infra*.) He further recommends certain medicinal agents internally and the application of certain solutions to the sores.

Wrightson (*loc. cit.*), p. 204, describes a specific instance of an outbreak of the disease.

With regard to the differential diagnosis of the disease there is a possibility, once the idea has been mooted, of regarding this disease as the same as, or analogous to, cow-pox in cows. The lesions, however, though resembling in their later stages cow-pox lesions, have nothing in common in their early manifestations with that disease. The lesions here are not umbilicated and they commence not in the epithelium itself, but in the deeper layers of the skin. Because it was thought advisable, however, in the outbreaks under consideration to exclude this possibility, inquiries

were made regarding the occurrence of cow-pox in cows (some of which were supplying the milk to the lambs) or of vaccination in children, with negative results. Similarly "Grease" in horses, said by some to have a relation to cow-pox, was inquired about, again with negative result. "Orf," a disease affecting the mouths and coronets of older lambs, is easily distinguished. Sheep-pox and foot-and-mouth disease need hardly be mentioned, for confusion with these diseases, at least in this country, would appear to be out of the question.

The next point to be discussed is the mode of dealing with the disease in the flock and in the individual sheep. First as regards the flock, provided the proper measures are taken early, the disease is very easily controlled, as is exemplified in the outbreaks recorded above. Above all things, the shepherd should be able to recognise the disease and be aware of the bad results that will follow if the disease is not properly dealt with. A careful scrutiny should be kept for lambs with sore mouths and ewes with sore teats, and the occurrence of sore mouths among the "pet" lambs should be regarded as a danger signal. The bottle used for feeding lambs affected with the disease should never be used for feeding healthy lambs, and, if possible, the duty of feeding such diseased lambs should be delegated to someone who has nothing further to do with the flock.

When a case occurs the ewe and lamb should at once be separated from the main flock and the ewe separated from her lamb. Diseased ewes may be kept together and so may diseased lambs. On no account should the ewe and lamb be kept together, but for the advantage of both they should be separated at the earliest possible opportunity. The ewe may have only one diseased teat, a circumstance which might encourage the shepherd to keep them together, but the lamb, being poorly fed and hungry, will as often grip the diseased teat as the healthy one, lacerating it still further. There is further the practical certainty that by such a measure the disease will be spread to the healthy teat. Further, the very act of the lamb sucking is a physiological stimulus to the udder to secrete more milk, with the result that more milk is secreted on the damaged side and cannot get away. The udder on that side, therefore, becomes harder and more swelled and the tendency for udder clap to develop is greatly increased. Apart from this, the very act of the lamb attempting to suck is accompanied by pain, which makes the ewe struggle. By this means her own sores are further damaged and at the same time those on the lamb are also lacerated, while fresh ones may be started on the nose, face and eyes of the lamb. By this procedure of keeping the ewe and lamb together an ever-widening vicious circle is set up, fraught with ever-increasing danger to both ewe and lamb and with no compensating advantage.

The ewes should be handled as little as possible and every endeavour made to get the milk off them as soon as possible. On no consideration, and especially so in the more advanced cases, should any attempt be made to milk them. The disappearance of the milk may be assisted by saline purges internally and belladonna liniment applied to the udder. The sores of the udders of

the ewes, as well as those of the nose and face of the lambs, should be treated locally, as indicated below.

Besides these measures, on the chance of an undiscovered case in the flock, box-feeding should immediately be stopped or the lambs should be shed off from the ewes while the latter are at the boxes.

With regard to the local treatment of the sores, the scabs should be removed and where possible a 1 per cent. ointment of ammoniated mercury or ichthyol applied. Where the use of an ointment is impracticable, as in the mouth of the lamb, the cleaning of the ulcers may be carried out and this followed by a thorough application of some non-poisonous cleansing agent, such as permanganate of potassium solution or hydrogen peroxide.

[I desire to express my thanks to Mr Jas. K. Bell, Agricultural Executive Officer for Roxburgh and Berwick, and to Mr J. A. S. Watson for their generous help in connection with this inquiry, as also to the farmers and shepherds whose flocks were implicated for the readiness with which they supplied me with material and information.]

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THE GAME AND HEATHER-BURNING (SCOTLAND) COMMITTEE.

THE relations between agriculture and sport have in Scotland been for generations the subject of controversy, which has, like many other controversies, assumed a more acute form under war and post-war conditions.

During the course of the war numerous emergency measures were adopted for the increased production or conservation of food in Scotland. Among these were Defence of the Realm Regulations 2Q and 2R, by which extensive powers were conferred upon the Board of Agriculture for Scotland with a view to preventing or reducing injury to crops and trees and wastage of pasture by deer, birds, hares, rabbits and vermin, and to securing for the food supply of the country "any migratory kind of wild bird," and Regulation 2M (10), under which occupiers of land received greatly increased facilities for the burning of heather. The Board gave effect to their powers under Regulations 2Q and 2R by the issue of many general and special Orders, the most important of which were the Killing of Deer Order of 27th September 1918, the Winged Game Order of 2nd August 1918 and the Rabbit Orders of 4th April and 14th June 1917. Of these the Winged Game Order expired on 31st December 1918, the Rabbit Orders were withdrawn on 30th April 1921, and the Killing of Deer Order lapsed on 31st August

1921, which was fixed by Order in Council as the date of the termination of the war. Regulation 2M (10), which was directly operative, no Order being required, also lapsed on 31st August last.

Section 10 of the Corn Production Act, 1917, which came into force on 1st January 1921, gave the Board of Agriculture for Scotland power to secure the destruction of rabbits and vermin where this was not sufficiently carried out by the responsible persons. This provision has, however, been repealed by the Corn Production Acts (Repeal) Act, which received the Royal Assent on 19th August 1921. Under the Forestry Act of 1919 the Forestry Commissioners received power to deal similarly with rabbits, hares or vermin where damage is being, or is likely to be, caused by them to trees or tree plants. So far as agriculture is concerned, however, the only permanent change that has been made in the law regarding damage to crops or food-stuffs is the passing of the Rats and Mice (Destruction) Act, 1919. Otherwise the pre-war situation remains unaltered.

It will be remembered that a good deal of controversy arose as to the effect on the farming and landed interests of the Regulations and Orders that have been mentioned. The Secretary for Scotland was urged on the one hand to take legislative action for the purpose of making them permanent, and on the other to allow them to lapse as purely war measures, which should have no place in permanent policy. He therefore appointed in November 1919 a Committee under the chairmanship of the Duke of Buccleuch, to consider—

1. With special reference to Regulations 2Q and 2R of the Regulations for the Defence of the Realm, and the Orders of the Scottish Board of Agriculture made thereunder :

Whether any, and if so what, permanent measures are required to protect cultivated land, pastoral land and plantations from damage by deer, birds, whether game birds or not, hares, rabbits and vermin?

2. With special reference to Regulation 2M (10) of the Regulations for the Defence of the Realm :

Whether the provisions therein contained should be permanently enacted, with or without modifications, and if with modifications, with what modifications?

The Report of the Committee was presented to the Secretary for Scotland in July, and has been issued as a Parliamentary Paper (Cmd. 1401), to be obtained from H.M. Stationery Office, price 6d., or by post 8d. The signatories are the Duke of Buccleuch, Sir David Wilson, Bart., D.Sc., Mr John D. Hope, M.P., and Messrs John Elliot, G.A. Ferguson, Hugh S. Gladstone and J. M. Hannah. A Minority Report presented by Mr James Scott, S.S.C., is appended. The Committee held twenty-one meetings, at thirteen of which evidence was taken from fifty-two witnesses, representing all the interests involved. A summary of the evidence will be issued as a separate publication.

The principal Report, after passing briefly in review the Regulations and Orders concerned, and describing the procedure

adopted by the Committee, goes on to deal with the present state of the law. Remarking that the definition of game is a matter of considerable difficulty, owing to the variation in its classification in various Acts, but a matter that they are not called upon to decide, the Committee proceed to summarise the provisions of various Acts dealing with the subject. They point out that much dissatisfaction appears to exist among farmers with regard to the provisions for compensation for damage by game other than ground game, laid down in Section 9 of the Agricultural Holdings (Scotland) Act, 1908, and that while an occupier cannot divest himself of his rights under the Ground Game Acts by any agreement, arrangements are frequently made that in effect evade this provision. Reference is then made to the recommendations of the House of Commons Game Committee, 1872-1873, the Napier Commission, 1884, the Committee on Food Production in Scotland, 1915, and the Agricultural Policy Sub-Committee of the Reconstruction Committee, 1918. The last-named Committee expressed regarding the provisions of the 1908 Act an opinion similar to that quoted above from the present Committee's Report.

The next section of the Report deals with the Agricultural Committees, on which the Committee propose to lay a number of new duties. Their history and constitution is therefore dealt with somewhat fully. The Report was drafted before these Committees received a statutory constitution on the coming into force of Part IV. of the Corn Production Act, 1917 (see note prefixed to the Report). The Corn Production Acts have been repealed by the Repeal Act mentioned above, but Section 1 (*d*) of that Act provides that the Agricultural Committees in Scotland may remain in existence.

Deer.—Dealing with the subjects of reference in the order of the remit, the Committee first take up the important question of damage by deer. Convinced that the damage caused by deer to crops and grazing land is widespread and serious, they regard fencing as the only effective remedy. In view, however, of the heavy cost of fencing at present, they recommend that it should be made compulsory only when economic conditions permit. They propose that in the meantime the power given to an agricultural tenant under the Deer Order to kill deer causing damage should be made permanent, so far as cultivated land and enclosed meadows are concerned. As regards grazing land, they recommend that the Board of Agriculture for Scotland should have power, where they are satisfied on the advice of an Agricultural Committee that damage is anticipated or is being done by deer, firstly to call on the proprietor of the land from which the deer come to prevent the nuisance, and, failing this, to give authority to the occupier to shoot the deer. It may be noted that while damage by deer is mainly a Highland problem, cases have occurred in Lowland areas. The Committee have therefore included not only red deer but all species of deer in their recommendation.

Birds.—With regard to winged game, the Committee find that pheasants in their natural numbers are harmful to agriculture only on rare occasions, but that the practice of hand-rearing

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excessive numbers of these birds often results in severe agricultural loss. Grouse do considerable damage to crops on upland farms adjoining moors in late harvests. Black game, while less widely distributed, do no less damage than grouse where they are plentiful; they also at certain seasons do extensive damage to young coniferous trees. Partridges do not appear to cause any damage, nor are complaints made against the capercaillie except from the point of view of afforestation.

The Committee are of opinion that much of the damage caused by grouse would be prevented by the use of grain-drying racks, and they recommend that the Agricultural Committees should endeavour to arrange for co-operation in the erection of these racks. On the general question they recommend that the Board of Agriculture should receive powers similar to those proposed in the case of deer damaging grazing land. This would be in effect a perpetuation of the Winged Game (Scotland) Order, which was in force from 2nd August to 31st December 1918.

Where wild duck are hand-reared, they should be included in the proposed regulation regarding winged game, but it is thought unnecessary to recommend any action regarding wild geese and wild duck in their natural numbers.

The Committee go on to say that they are persuaded that in Scotland as a whole wood-pigeons (described as "an agricultural pest of the worst description"), sparrows and rooks cause more damage than all game birds put together. Evidence was also adduced as to the increased havoc wrought by the larger gulls among ewes and newly born lambs. The Committee therefore recommend that the Board of Agriculture for Scotland, through the medium of the Agricultural Committees, should take steps to secure organised effort by owners and occupiers of land to keep down wood-pigeons, sparrows, rooks, crows, herring gulls, lesser black-backed gulls and greater black-backed gulls. In this connection they offer certain criticisms on the scheme published in the Board's Eighth Report (Cmd. 773), p. lxxii.

Ravens and golden eagles are protected by schedule in many of the county Orders for the protection of wild birds. In some districts they have, however, become too numerous of late, and do considerable damage to ewes and lambs. It is therefore recommended that the Secretary for Scotland should be empowered to grant licences for the destruction of these birds to owners or occupiers of land who are suffering damage from them.

Plantations are included among the subjects of damage in the Committee's remit. As, however, the Forestry Commissioners have power to protect woodlands against damage by hares, rabbits and vermin, the Committee have confined themselves to the consideration of damage by birds, and they recommend that the Board of Agriculture for Scotland should be empowered to grant authority for the killing at any time of black game that are damaging plantations of young conifers.

The Committee make no recommendation regarding the provisions for compensation in Section 9 of the Agricultural Holdings (Scotland) Act, 1908. This is in accordance with the general principle laid down at the beginning of the Report: "We have

assumed that it was intended that these matters should be considered from the national point of view, mainly that of food production. We have therefore thought it our duty as far as possible to advocate measures to prevent damage rather than to provide compensation for damage done."

Finally, commenting on the conflict of evidence as to the food of birds, the Committee point out the need for continued scientific investigation of the subject, and welcome the appointment by the Secretary for Scotland of an Advisory Committee to advise him regarding the administration of the Wild Birds Protection Acts: "Indiscriminate slaughter of birds is at all times to be avoided, since many birds, on account of their insectivorous habits, are among the best friends of agriculture."

Hares and Rabbits.—The Committee express the view that the powers conferred upon agricultural occupiers under the Ground Game Acts have not in every case proved effective in preventing damage to crops by the rabbit, which is "with the possible exception of the rat, the most serious four-footed pest that farmers have to deal with." Mention is made of certain irregularities or actual contraventions of the Ground Game Acts.

The Scottish Chamber of Agriculture unanimously passed a resolution to the effect that the rights conferred on agricultural tenants under the Defence of the Realm Regulations in respect of ground game found destroying crops should be continued. The Committee, however, regard the right of following game or vermin on to another man's land as one that should not be permitted by permanent legislation to an individual. Under Section 10 of the Corn Production Act, 1917, which, as already mentioned, came into force on 1st January 1921, the Board of Agriculture for Scotland had power to carry out the destruction of rabbits where the occupier had failed to destroy them sufficiently, with consequent damage to neighbouring lands. The Committee recommended that this power should be extended so as to cover anticipated damage, as in Section 4 of the Forestry Act. Since, however, Section 10 of the Corn Production Act has been repealed, the Board possess no power in the matter, and the whole recommendation of the Committee becomes a matter for fresh legislation. Mountain or blue hares are included with rabbits in this recommendation, but it is thought unnecessary to make any fresh provisions regarding brown hares.

Rabbits may, however, be looked upon from another point of view, that of food supply, and there is some waste or poor land that may perhaps best be used as rabbit-warrens. It is, however, essential that all rabbit-warrens should be efficiently fenced, and the Committee further recommend that new rabbit-warrens should be allowed only on land that appears to the Board of Agriculture for Scotland to be incapable of more profitable agricultural use.

Vermin.—Rats and mice are dealt with in the Rats and Mice (Destruction) Act, which came into force on 1st January 1920; squirrels are harmful only to trees and are dealt with by the Forestry Commissioners, and voles are not a permanent pest. The fox is therefore the only beast included under the head of

vermin that receives special attention. The evidence of damage to sheep stocks relates mainly to areas adjacent to deer forests, and it appears that in many parts of the Highlands foxes have increased in number in recent years. Agricultural occupiers have full legal power to destroy foxes, but the exercise of this power is a matter of great difficulty. Some doubt attaches to the legality of the use of poison for the killing of foxes. The Committee therefore recommend, in the first place, that if foxes are not included in the term "vermin" in the Protection of Animals (Scotland) Act, 1912, the Board of Agriculture for Scotland should be empowered, on the recommendation of an Agricultural Committee, to authorise the use of poison for the destruction of hill foxes. As, however, this is not sufficient for the protection of sheep stock, the Committee further recommend that the Board should receive powers similar to those conferred upon them with regard to rabbits by Section 10 of the Corn Production Act (now repealed). In this case, however, it is not proposed that anticipated damage should be a ground for action. Lastly, as it was represented to the Committee that traffic in fox-cubs leads to the preservation of foxes in districts where their extermination would be a national benefit, it is proposed that such traffic should be allowed only on licence, in writing, from the Board of Agriculture for Scotland.

Heather-burning.—On this subject the Committee begin by stating that it is generally admitted that heather-burning has been greatly neglected in many districts of Scotland and that there is much lack of knowledge of the advantages of burning in a systematic rotation. They are also satisfied that the output of mutton and wool from the hill grazings of Scotland would be considerably increased if the best methods of heather-burning were used everywhere. As to the reasons for neglect, where it exists, as to the working of Regulation 2M (10), and as to the permanent measures that should be enacted, they were faced by a remarkable conflict of evidence. They were led to the belief that the main sources of difficulty are—

- (1) The interest or supposed interest of the shooting tenant, who may be ignorant of the advantages of systematic burning.
- (2) The fact that, especially on some of the smaller estates, undue authority is relegated to gamekeepers.
- (3) The difficulty of burning a regular area of heather every year, owing to the variability of the season.

Considering broadly the problem of the control of heather-burning in future, the Committee are of opinion that it cannot justly be solved by making permanent the provisions of Regulation 2M (10), whereby it is placed in the hands of the grazing tenant, under certain safeguards. On the other hand, a simple recurrence to the provisions of the Act of 1772-1773 cannot be recommended, in view of the weight of evidence regarding the failure of these provisions to ensure fair treatment of the grazing tenant. The Committee therefore recommend that the Agricultural Committees, acting on instructions given by the Board of Agriculture for Scotland, should ascertain the arrangements in force on each estate in their respective areas. Where these appear to be unsatisfactory, the

Agricultural Committee should endeavour to obtain the adoption by voluntary agreement of a scheme that will secure the interests of all concerned. Failing such agreement, recourse should be had to compulsory power vested in the Board.

The onus of burning should rest with the proprietor, but where a proprietor transfers the responsibility to the grazing tenant, the Committee see no reason for objection. They agree with the evidence that was given to the effect that a system of co-operation between proprietor and tenant provides the best basis for carrying out schemes of burning.

On the question of the legal period for burning, the Committee propose that the normal season should be from 1st October to 15th April (instead of from 1st November to 10th April, as in the Act of 1772-1773), with extension to 25th April where this is warranted owing to the condition or the situation of the moor. This extension should be recorded with the Agricultural Committee, instead of being recorded in the Sheriff Court books, as under the existing Act.

MINORITY REPORT.

Mr James Scott, in presenting his Minority Report, states that while the proposals made by his colleagues mark an advance on existing legislation, he is unable to agree that their recommendations are adequate to the situation. "The appointment of the Committee is a testimony to the fact that the interests of game and the tyranny of sport have been allowed to predominate in Scotland to an extent which is inimical to national interests." He therefore recommends, with regard to deer, that all land in deer forests suitable for cultivation, grazing or afforestation should be deforested by statute; that all remaining forests should be adequately fenced within three years; that Defence of the Realm Regulation 2Q should be made permanent; that full compensation should be paid for damage done by deer, to be assessed by the Scottish Land Court; and that the use of food-stuffs for the hand-feeding of deer should be made illegal.

With regard to rabbits and hares, Mr Scott proposes to confer permanently upon agricultural tenants the rights they enjoyed under the Rabbit Orders, with certain modifications; to enact a penalty for contracting out of these rights or those provided by the Ground Game Acts; and to provide compensation for damage where the stock of rabbits or hares has been increased.

He further recommends that agricultural tenants should have full right to kill and take winged game or other wild birds on their holdings; that Section 9 of the Agricultural Holdings (Scotland) Act should be largely amended as regards both matter and procedure; that it should be made illegal for a landlord or an occupier to let shootings on a holding and for a landlord or shooting tenant to enter upon any holding for the purpose of hunting, shooting or fishing; and that any tenant suffering damage from any kind of game, foxes, vermin or pest should be empowered to apply to the Scottish Land Court for an inquiry, and for an Order (if so advised) upon the owner of the land in which they harbour to destroy them. The duty of compelling a tenant to keep down game, vermin and

pests on his holding is also proposed to be laid upon the Land Court, at the instance of the Board of Agriculture for Scotland. Certain amendments on the Small Landholders Acts, relative to these matters, are also proposed.

With regard to heather-burning, Mr Scott recommends that the Act of 1772-1773 should be repealed, and that the occupier of any land should permanently receive the right conferred by Regulation 2M (10). Neglect of burning should be dealt with by the Scottish Land Court, at the instance of the Board of Agriculture or the proprietor of the land. Mr Scott further proposes that effect should be given to a recommendation of the Deer Forests Committee that heather-burning should be allowed in deer forests up to 31st May, a recommendation in which his colleagues were not prepared to concur.

Mr Scott devotes a considerable part of his Report to a discussion of the origin and composition of the Agricultural Committees, to which his colleagues propose to entrust many important duties. He arrives at the conclusion that these bodies are altogether unsuitable, and that the enforcement of the new legislation proposed by him should rest either (as in his actual recommendations) with the Scottish Land Court or with some new *ad hoc* body "whose orders will have behind them the weight of judgments of law."

AGRICULTURE IN DENMARK.

THE following notes are extracted from the report of Mr Thos. Hunter, a student of the West of Scotland Agricultural College, who attended a course of agricultural instruction in Denmark, including lectures and excursions, in the summer of 1920.

To-day dairy farming and seed production are the two great pillars of the Danish agricultural system, beef production being comparatively unimportant, but at one time the reverse was the case. Indeed Danish agriculture seems to have passed through three phases: (1) the production and export of beef; (2) the production of corn; and (3) dairy farming, specialising in the production of butter.

In the earlier days the Jutland breed of cattle was pre-eminent and held in high regard for the quality of its beef. The main cause of the breakdown in the feeding trade was the loss of the Flemish market, a subsidiary cause being the outbreak of cattle plague which greatly depleted Danish stocks. The large estates took the lead, broke up their pasture land and adopted cereal growing along with dairy farming as a new departure in their agriculture.

Dairy Farming.—The Danish farmer is very fortunate in the possession of an admirable native type or breed of cow—the Danish Red. In earlier days the breed seems to have been but indifferently managed and indiscriminate crossing with foreign breeds resorted to.

The Ayrshire appears to be viewed with a rather intolerant eye. The objection seems to be founded on two points. According

to the Danish farmer: (1) as a breed the Ayrshire cow is tubercular; (2) as a breed the Ayrshire cow is not adapted for the production of butter. If there is a breed foreign to their own and in whose favour the Danes are prejudiced, it is the Jersey, and to a smaller degree the Guernsey, and here again we find a breed primarily adapted for butter production. Hence a good deal of crossing is done with the Danish Red bull and the Jersey cow, the cross resulting in an animal combining the rich milk of the Jersey with the yield of milk and constitution of the Danish Red. A good number of these crosses were seen on various farms.

To grade up the stocks, Cattle-breeding Societies were formed which did much to discourage crossing with foreign breeds and strove to introduce improvement by judicious selection and mating within the native breed. The State in due course came to the aid of these societies, placing funds at their disposal.

At first the associations started on a small tentative scale and as the spirit of co-operation was fostered their local areas gradually extended into larger associations taking in considerable districts. Each local society had its adviser, who kept in touch with the other associations. To-day the co-operative movement has reached great magnitude and often one farmer is a member of fifteen to twenty different societies. In Denmark most of the farmers own their own land and to this is attributed much of the success of the co-operative movement. The size of the farm is usually small—of the 250,000 only 9000 exceed 150 acres. The tendency to-day is to increase the number of holdings and decrease the size still further. Even the so-called "large estates" whose day is quickly passing will not compare in size with our large estates in Britain. The law requires one farm to one farmer. All, practically, keep cattle and pigs, which further tends to foster co-operation.

The Cattle-breeding Associations did much to promote interest and progression in the movement by purchasing good bulls and breeding with the best cows owned and recognised by the societies. Indeed members of the Breeding Societies bound themselves to use no bull which was not approved by their committee of judges and to breed within their two native breeds—*i.e.* the Danish Red of Sealand and the black and white Jutland cattle. For show purposes a bull is not eligible for a prize without showing records of its dam. It is judged from three standpoints: (1) individual type; (2) record of its female ancestors; (3) record of sire. Certain other conditions were imposed on the members of the Breeding Societies all tending to the production and use of the best obtainable and conferring on the members as a whole certain privileges which did not extend beyond the societies.

Another great advance which the Cattle-breeding Associations were largely instrumental in bringing about, was the introduction of the Milk Recording Associations or "Control Societies" as the term is in Denmark. The aim here was to give the owner reliable means of determining the milk-productive powers of the units of his herd, eliminating the less profitable units, and ascertaining the economic worth of each cow.

The control assistant or milk tester gets his training in a

three months' course at one of the agricultural schools. In the pursuit of his duties he is housed, boarded and conveyed to the next farm on his round—much similar to the Scottish system. Visits are made once or twice a month, milking may be done twice or four times in the day. Records are taken as to yield of milk, percentage of butter-fat, weight and nature of ration, date of calving, and the branding or ear-marking of calves dropped since his last visit, denoting sex, sire and dam in each case.

Under the incentive of State recognition and financial encouragement these Milk Recording or Control Societies steadily multiplied, and multiplying found growing need for co-operation among themselves and also with the Cattle-breeding Societies. Delegate meetings were held and common rules and regulations agreed upon for the execution of their work.

There are about 700 such controlled societies with about 250,000 cows. Each society gets about 200 kroner per annum from the Government, but to be eligible for this grant the societies must have at least ten members with 200 cows and must submit an annual report giving a complete record of each cow as detailed above.

As has already been said, large farms are the exceptions in Denmark, a common size being probably about 50-60 acres, while innumerable small holdings do not exceed 20 acres. One holding visited on 7th July was only five acres in extent, the live stock being represented by three cows, one pig and a few hens. All the labour was done by the farmer, his wife and a son of minor age. Income was augmented by working occasionally for the bigger farmers, from whom, by way of part payment, the small-holder had the use of a horse to do his ploughing and cultivating. The average size of the Danish holdings might be put at $\frac{1}{2}$ to $\frac{3}{4}$ that of the holdings in this country. Labour is not so vexed a question as with us, since the great majority of farmers own their land, the working of which is performed by the members of the family. Where the labour is hired, the cost would seem to be much on a par with what rules here.

A typical rotation for a large farm—say 200 acres or more—would be on the eight years' shift. Quite frequently, however, a five years' rotation is adopted.

Of all the root crops cultivated in Denmark, sugar beet and mangolds easily come first in importance—the beet grown for its sugar as an article of commerce, the mangold as a food for live stock. Though the soil and climate of Denmark are well adapted for the growing of turnips and swedes, these are grown only on a small scale for cattle feeding, though with cabbages they are grown extensively for their seed. Mangolds and lucerne hay make the backbone of winter dairying. The live stock on the above-mentioned farm was composed of—

Milch cows	..	..	..	..	56
Followers	..	..	..	..	40
Horses	..	..	..	..	7 pair
Pigs	..	..	..	..	50

Relative to many other farms this holding was pretty lightly

stocked due to most of the beet being sold to an adjacent factory.

An important source of cattle food to the farmer is the refuse or pulp from the sugar factories, which amounts to about 60 per cent. of the total weight of beet. The price charged to the farmer is 1s. per cwt.

During the tour several small holdings were visited. The present trend is towards the creation of more and more of these holdings. Special facilities are granted as encouragement. About 90 per cent. of the required capital is advanced by the Government at a low rate of interest—say 2 to 3 per cent.—repayable in 30 to 40 years. But the applicant must show himself possessed of some agricultural knowledge and experience ere he is eligible. A concrete example of one such holding visited was twelve acres in size, nine of which were arable and three laid in permanent pasture.

The experiment laboratory of the Royal Veterinary and Agricultural College, Copenhagen, placed its services at the disposal of the creameries reporting on the quality of their butter. Surprise visits are made to the various creameries several times a year, samples of the produce taken, examined by experts, analysed, judged and the results made known to the various sources, with information as to the probable cause of any defects, and advice as to measures of amendment.

Participation in these schemes, at first voluntary on the part of the various creameries, has now become compulsory—at least so far as export butter is concerned.

A visit was paid to the laboratory, where the party viewed the methods used for examining, judging and scoring on the samples of butter sent in from the factories. The significance of the Lurbrand (the hallmark of Danish export butter) was explained, and the conditions and standard which must be satisfied before such a brand could be stamped upon the kegs were defined. Any sample failing to reach the set standard was straightway rejected for export purposes and reported to the responsible factory.

Live-Stock Management.—In the manner of management of their dairy herds the Danes differ very considerably from ourselves. In this country pasture is the backbone of dairy farming, while on many farms in Denmark, especially in Jutland, the amount of pasture is very small and in some cases practically nil. Forage crops are made to take the place of grass pasture for the summer feeding of cows. These are not allowed to roam at will within closed boundaries—indeed there may be no walls or fences at all on the farm. Instead they are tethered in a long line, the tether pins being shifted forward as often as required—say twice daily—thus advancing gradually over the area until the crop is eaten over once, when it may either be gone over again or turned over with the plough in preparation for the succeeding crop.

From neither heat nor flies can a herd of cows thus tethered obtain relief. Neither can they seek water at inclination. Their water supply has to be brought to them—frequently from the steading by water cart and apportioned out to the herd. This

means considerable labour, as one watering per day will not suffice. Much time and labour are also required in tethering a big herd of cows, two or three or even four times a day.

Horse-breeding has received great attention on the part of the responsible societies and individuals. Just as there are bull clubs in the cattle-rearing trade, so are there corresponding institutions whose primary object is to foster improvement in horse-breeding and the use of only the best blood procurable. As with cattle, the initial efforts at improving the Danish breeds lay in crossing with foreign blood, but this was afterwards abandoned and improvement sought along the lines of judicious selection and mating within the native breeds. At one time the State lent very considerable financial aid towards the work until a growing sense of the importance and value of good breeding proved a sufficient incentive to breeders without the encouragement of State aid.

As with other kinds of live stock, the Danish pig-rearing industry has shared in the great grading-up process—not only in quality but also in number. Thus from a total approximating a quarter of a million in the earlier part of the nineteenth century the number gradually increased to about three millions in 1914, after which there came a diminution consequent upon increasing difficulty in obtaining suitable feeding stuffs during the Great War. Pig-rearing naturally followed as a sequel when grain production gave way to dairy farming, the by-products of the dairy affording a cheap and valuable food for the pig.

The Danish pig is greatly indebted to our English breeds, particularly the large white York, for its improvement. It is a large breed, hardy and prolific, but inclined to coarseness, and crossing with the large white Yorkshire has given a better quality pig producing bacon more favoured in the English markets, upon which Denmark is so dependent.

Breeding centres have been established throughout the country and utilised as sources from which the best animals can be obtained for breeding purposes.

The trade is mostly worked on the co-operative system (so integral a part of Danish agriculture) and the State has once more given a helping hand in financial encouragement. In the competition between co-operative and private bacon factories the former has won the field, there being about fifty such co-operative factories altogether in the country. One of these—namely, the Esbjerg Co-operative Bacon Factory—is an immense concern, capable of putting through 900 pigs in a day.

A veterinary surgeon appointed by the Government is always present, whose duty it is to examine each carcase and its organs for symptoms of tubercular disease or rhachitis. According to his finding, the carcasses are graded. Only sound carcasses may attain class A1, and be eligible for export purposes, and such have a right to the Lur-brand for export bacon, which closely resembles the Danish hallmark for export butter.

Slightly tubercular pigs may be used for human consumption at home, but must first be subjected to a sterilising process. Carcasses bearing evidence of more advanced disease are condemned for human consumption, and the remains of such we saw utilised

in various ways—their fat extracted and used in commerce, and the waste meat dried, crushed to a meal and used as a cattle food. Great quantities of this meal we saw on the premises mixed with chopped hay.

The Egg Export Trade.—On a visit to the premises of the Danish Co-operative Egg Export Society opportunities were afforded of seeing the manner in which vast numbers of eggs are handled prior to being finally packed for export. Particularly interesting was their method (by means of electric light) of checking unsound eggs, all those showing evidence of staleness being rejected.

In a short address the director of the establishment spoke of the great development of the egg export trade in Denmark—how from a small beginning in 1865, when the trade was opened in England, it steadily increased in volume until interrupted by the outbreak of the Great War, during which the country's stock of hens had to be reduced by about 5,000,000.

Apparently one of the contributing causes of the greatly enhanced reputation of the Danish egg market was the elimination of hucksters, who, in collecting from the various egg producers, did not scruple to hold back their stocks in anticipation of a rising market and consequently flooded the English markets with unsound eggs.

Now the trade is controlled under an organisation termed the Danish Co-operative Egg Export Society, established in 1895. This central society has its headquarters in Copenhagen and is also represented by over 500 local branches scattered throughout the country. It has proved very effective in improving the whole industry, for even those egg producers outside the society have been forced to pay more attention to the quality of their produce if they wished to retain a market at all.

The local branches work, of course, in co-operation with the central society. They appoint their own committees and representatives and are bound by the same regulations operating within the central society. Each local branch must have at least ten members. It is an obligatory condition of membership that all eggs beyond those required for the producer's actual household purposes must be delivered over to the society for collection. Collection is made at least weekly, while at the farms the eggs are gathered daily, and in hot weather twice daily. All eggs must be sent into the collecting centres in a fresh condition, under penalty of a fine, and must bear the stamp representing the producer within the area of his particular branch society. Each society likewise adds its own distinctive stamp. The local branches forward their stocks to the egg export centres, where all the eggs are examined and sorted. Sound eggs are stamped with the export mark and are immediately made ready for shipment, packed in flat boxes four layers deep. All unsound eggs are rejected and, by the system of stamping, can be traced back to the producer through the medium of the concerned local society or societies.

Field Experiments.—The first experimental field dates back almost to the middle of the nineteenth century and, in the main, the procedure followed has been that of our Rothamsted Station.

At present there are six large agricultural experiment stations, supplemented by other two of lesser size, while horticultural interests are represented by three experiment stations. In size the stations vary from 30 to 50 ha. (70 to 130 acres), and are either purchased outright by the State or are taken on a long lease. Each is furnished with a laboratory for research work in chemistry, bacteriology and entomology.

The conducting of the work of all these stations devolves upon a committee of five members—three representing agriculture and two horticulture. The agricultural and horticultural organisations, as well as the Royal Agricultural College, have a voice in the appointing of these members, and finally their appointment must receive the approval of the State.

Each experiment station is supervised by a director, who is held responsible for the working and economy of his station. As a rule he is assisted by one or two scientific assistants. The various directors meet and plan out schemes for experiment—*e.g.* variety tests—and these schemes are submitted to the above committee of five for approval before being given over to the various stations. "Joint problems" are carried on simultaneously at a number of stations and for an extended period—2-4-6 years. General supervision is done by one person, whose duty it is to collect data and finally render his report.

Besides these joint experiments each station is allocated its particular problems to work out. Actual planning of the experimental plots is much similar to our own method, and natural variations of soil are negatived or checked by replicate plots after the draught-board system. The size of the plots usually runs to about twenty-five square metres. Publication of the results of these field experiments lies in the hands of the secretary of the Central Committee, and is of three distinct kinds:

- (1) Complete reports of each series of experiments.
- (2) Pamphlets of instruction to farmers and agricultural schools.
- (3) What are termed "Dissertations" of a highly technical nature, which are not reprinted.

While the State experimental stations deal mainly with questions of general application, local problems, applicable to the district, are taken in hand by the lesser agricultural associations (about 100 in number) scattered throughout the country.

Agricultural Education.—The ordinary education of the city boy or girl is conducted along similar lines to those prevailing in this country. In rural districts attendance at school is compulsory up to thirteen years of age, but only three days per week instead of five. If further education is desired by one making a speciality of agriculture, there are the "Agricultural and Dairy Schools." These are scattered throughout the country, numbering about twenty, and the oldest and largest is the one at Odense. An average number of students at one of these institutions might run about 100, making an aggregate of 2000 students in all.

The course extends eight months—*i.e.* from November to April—followed up by another three months devoted to applied agriculture. The course is entirely theoretical, even in the

dairy branch, presuming as it does—(a) a previous four years' practical experience of farming or in a creamery and (b) a fair general education. Subjects treated are Chemistry, Physics, Botany, Anatomy, Plant and Animal Husbandry, Physiology.

Attached to the school are grounds extending to 100 acres and managed as an ordinary farm.

The fees are 100 kr. per month, including board, lodging and instruction. Scholarships may be gained to the value of one half the fees and eligible only to those with limited means. This and similar institutions receive a State subsidy of 2500 kr. per annum. The State does not interfere in the management or attempt control, leaving the framing of curriculum, etc., entirely in the hands of the responsible council mentioned.

At the conclusion of the course most of the students return to their homes, but several always elect to go forward to the College at Copenhagen to gain greater proficiency in their calling in life. In age the students vary from eighteen to thirty years, students of less than eighteen years of age being discouraged. Evidence of sufficient general education is obtained by means of a test examination at the beginning of the course.

In somewhat similar institutions—carried on on a smaller scale in smallholders' schools, likewise subsidised by the State, but initially built and supported by the smallholders' societies—a short course of 7 to 12 days has been instituted for the special benefit of farmers and their wives whose scholastic attainments are meagre. A simple curriculum is drawn up for their course of study, but the basic idea is really the promotion of social intercourse and good-fellowship. These short courses are remarkably popular and well attended, affording as they do a triple benefit—namely, educational improvement, opportunities for exchange of ideas, and relaxation from the monotony of a somewhat laborious life.

Conclusion.—While I should not wish in any way to belittle the remarkably high state of development which Danish agriculture has attained in many of its branches, and which is directly attributable to the indefatigable industry and spirit of co-operation unequalled perhaps in any other country, I think Denmark is very fortunate in (1) her geographical position giving a ready market for all her surplus produce; (2) the uniform type of soil so amenable to cultivation; and (3) a type of dairy cow admirably suited for its purpose.

With the exception of the waste peaty and sandy heath land in the neighbourhood of Herning, so far as our tour brought the country under our observation, Denmark has remarkably little land which cannot profitably be brought under the plough: most of the soil varies from a sandy to a good heavy loam. It may be that the winters are severe, but the ability of the Danish farmer to raise forage crops so successfully speaks well of the climate and the kindly nature of a soil which seems capable of producing crops of widely differing habit, from rye to wheat, potatoes to mangolds, beans to lucerne, with almost equal success. Yet it is the human factor which counts most, and the Danish farmer took a shrewd

step when he abandoned meat production for corn production combined with dairying, which transition has met with such signal success.

In one matter especially the Danes differ greatly from us—namely, in their apparent indifference to the utilisation of sheep. One might have thought as economical a way as any of utilising the heather-clad areas of the Herning district would have been by the breeding and rearing thereon of sheep, but this does not seem to appeal to the Danish farmer. So far as we could see, the sheep is a negligible factor (apart from Iceland), and throughout the tour we did not see above a score of sheep—outside the two agricultural shows visited on 8th and 17th July.

An instance in which the Danish farmer scores very considerably is the care and thought he gives to the management of his farmyard manure. I think I am justified in saying he gets about 25 per cent. more out of it than is common in this country.

But the great outstanding feature dominating Danish agriculture is the spirit of co-operation permeating its entire structure and giving rise to numerous societies, each entrusted with its own particular business, whether it be the breeding of live stock, the purchase of seeds, manures or feeding-stuffs, the exporting of dairy produce, milk recording or rural credit. All such societies are working for the same end—the advancement of their agricultural interests and the improvement of the peasants' social and financial status.

Finally there may be mentioned the co-operation between science and practice, the keenness of the farmer to glean any knowledge bearing upon his business. It was most observable at the agricultural shows—the interest which all took in visiting the stalls exhibiting specimens of grasses, clovers, cereals, roots, disease specimens, etc., poring over any literature thereon, and following with close attention dissertations upon these matters by the demonstrators in attendance. Moreover, what the Danish farmer hears in the lecture-room he is not afraid to put to the proof in the field.

In the *Journal* for January of this year an account was given of the provisions of the Agriculture Act, 1920, which was intended to stand as the expression of a permanent policy for agriculture, subject to withdrawal (so far as the Corn Production Acts were concerned) by Order in Council, to take effect four years after its promulgation. On 19th August last, however, Royal Assent was given to the Corn Production Acts (Repeal) Act, by which the Corn Production Act, 1917, and Part I. of the Agriculture Act (together known as the Corn Production Acts, 1917 and 1920) were repealed as from 1st October. Its effect is to do away with minimum prices for wheat and oats (except as regards the present year), compulsory minimum wages, and the measure of control over agricultural operations that was provided in the repealed Acts (except as regards injurious weeds). On the other hand, Part II. of the Agriculture Act, which amended the Agricultural Holdings Acts, remains almost unchanged. The

new Act, further provides a substantial fund for promoting agricultural development.

Section 1 of the new Act repeals the Corn Production Acts as from 1st October, with certain provisos, the first of which is that payments shall be made in respect of wheat and oats of the year 1921. Instead, however, of the elaborate procedure laid down in the Corn Production Acts for determining the amounts payable, it is provided in Section 2 of the Act that these amounts shall be £3 per acre for wheat and £4 per acre for oats, payable on 1st January 1922. The provisions regarding negligent cultivation, etc., remain in force. The estimated sum required is in England and Wales £15,000,000, and in Scotland £4,400,000.

The first proviso also reserves certain powers exercised by the Board of Agriculture for Scotland or by local authorities regarding the occupation of land under the Defence of the Realm Regulations.

The second proviso relates only to England and Wales, but the third provides for the continuance of the powers conferred upon the Board of Agriculture for Scotland by Section 4 (10) of the Agriculture Act regarding injurious weeds. These powers are set out in detail in the Schedule to the Act, which also specifies the weeds with regard to which the Board's powers are exerciseable—viz. Spear Thistle, Creeping or Field Thistle, Curled Dock, Broad-leaved Dock and Ragwort.

The fourth proviso applies only to Scotland, and provides for the continuance of the Agricultural Committees (which were constituted under the Corn Production Acts in the spring of this year) until by Order in Council it is directed that their powers shall be exercised by the Board of Agriculture for Scotland. A draft of any such Order must be laid before each House of Parliament for thirty days, and unless both Houses by resolution approve of it no further proceedings are to be taken. This is an exceptional provision, the usual form being that a proposed Order or Regulation takes effect unless an address is presented against it.

Section 2 has been mentioned above, in connection with the first proviso to Section 1.

Section 3 provides that during the current financial year one million pounds shall be provided as "a special fund for promoting agricultural development, including the establishment of scholarships and maintenance grants for the sons and daughters of agricultural workmen and others," but excluding the provision of small holdings. Of the total amount, £850,000 is allotted to England and Wales and £150,000 to Scotland.

The Central and District Agricultural Wages Committees in Scotland ceased to exist on 30th September, and it is proposed in Section 4 of the Act that they shall be succeeded by local joint conciliation committees representative of agricultural employers and workmen. The Board of Agriculture for Scotland therefore receive power "to take such steps as they think best calculated to secure the voluntary formation and continuance of such committees." As regards England and Wales, procedure is enacted whereby the decisions of the conciliation committees may become binding in law, but these provisions do not apply to Scotland.

Under Section 12 of the Agriculture Act the District Agricultural Wages Committees had power to determine cases where compensation was claimed by an agricultural workman on the termination of his occupation of a cottage. This power is transferred by Section 5 of the Repeal Act to the Sheriff Court, and the method of assessing the rent of the house for the purpose of fixing compensation is more precisely expressed.

Finally, Section 6 repeals Section 15 (1) of the Agriculture Act, which provided for the transfer in certain circumstances of permanent improvements from Part I. of the First Schedule to the Agricultural Holdings (Scotland) Act, 1908, to Part II. of that Schedule. This and the preceding Section are the only ones affecting Part II. of the Agriculture Act.

It may be mentioned in conclusion that besides losing such control over cultivation as they had under the Corn Production Acts, the Board are deprived of the power to require returns of crops and stock. The Annual Agricultural Returns, which were made compulsory in 1917 by a special Order, and in 1918 and subsequent years by the Corn Production Act, 1917, will thus revert in 1922 to their voluntary status.

ON behalf of the women's representatives who are contributing papers to the first World's Poultry Congress at the Hague, members

Egg Recording.¹ of Women's Rural Institutes have been collecting information on what women are doing for the poultry industry. As a result of this some interesting and instructive information has been received by the Board which it has been thought well to publish in the present article. Information has also been received from other sources and includes the article by Miss Gibb on her poultry balance sheet, which was published in the last issue of the *Journal*.

These egg records are part of a scheme recommended to individual Institutes for the holding of competitions in poultry-keeping, the records to be considered by the judges in conjunction with the results of an inspection of the poultry yards. The fact that thirty Institutes have been able to send in the daily records of eggs laid by ninety-three flocks of hens from 1st November 1920 to 31st April 1921 inclusive reflects credit on the keenness and ability of the Institute members, and is evidence of the value of the movement in developing interest in such important rural subjects as poultry management. In most cases only two or three members of an Institute sent in records, but Connel, Corrie and Hutton, Cairnryan, Kilmallie and Pitlochry Institutes sent in the records of from six to fourteen members per Institute. Tarbolton Institute sent in egg records from individual birds from one of its members. Of all record-keeping that of individual birds is the most valuable. Dunbar Institute sent in five record sheets from one member who kept separate records of five pens of birds (see below). This is valuable as it enables comparison to be made of the records of birds of different breeds and different ages kept under similar conditions. Next in importance is a comparison of

¹ Detailed figures from the records sent in are obtainable on application to the Secretary, Board of Agriculture for Scotland.

pens of different breeders in the same district such as can be made where Institutes have sent in records from several members; and, lastly, it is interesting to study the records from different districts as represented by the different Institutes.

Comparing the records of pens kept under similar conditions on the same farm, the results may be tabulated as follows:—

No. of Birds in Pen.	Breed.	Date of Hatching.	¹ Winter Average per Bird.	² Six Months' Average per Bird.	Remarks.
13	White Wyandottes	April, May, June, 1920	38	95	Many of the birds were broody in March and April.
15	White Leghorns	April and May, 1920	35	83	Pullets began to lay on 12th Nov.
14	Rhode Island Reds	4 in 1919 10 in 1920	36	72	Some of the birds were broody in March and April.
27	White Leghorns	1919	11	49	Hens began to lay on 3rd Nov.
19	White Wyandottes	16 in 1919 3 in 1918	25	61	

¹ The winter average per bird is the average number of eggs laid per bird from 1st November to 31st January inclusive.

² The six months' average is taken from the flock record for the six months from 1st November to 30th April inclusive.

With reference to the above table it is interesting to note—

- (1) That the larger number of eggs were laid by the Wyandottes.
- (2) That the pullets of either breed laid better than the hens.
- (3) That at this farm second-year Wyandottes laid much better in winter than second-year Leghorns.

(4) That though many of the Wyandottes were late hatched the winter records are good. It would be interesting to prove whether this is due entirely to a quickly maturing strain of birds or if the result has been influenced by feeding, artificial light or climatic and soil conditions, as birds of the same breed and hatched at the same time have not done so well in some of the other returns.

COMPARISON OF THE BEST RECORDS FROM DIFFERENT COUNTIES.

Aberdeenshire.—One record sheet was sent in from a member who has a flock of 100 birds, which include White Wyandottes, Light Sussex, Rhode Island Reds and crosses of these breeds with the Indian Game. The age of the birds is not given and the number of birds in the pen was much reduced before April. The winter months show an average of 12 eggs per bird, and the full six months 43 eggs per bird.

Argyllshire.—Eighteen record sheets were sent in, this being the highest number from any county. The best record for the county was from a flock of 17 White Leghorns which were hatched

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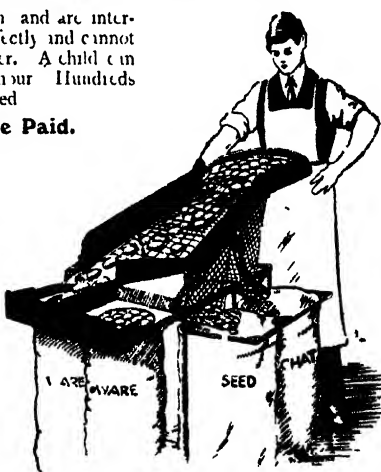
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on 26th May 1920 and started to lay on 4th November. The winter average was 29 and the six months' average 87 eggs per bird. Four of the hens were sitting on 12th April. Broodiness in Leghorns has been particularly noticeable this spring, and it is important to mark and exclude from the breeding pen Leghorns which have become broody, as broodiness, though not characteristic of the breed, is an inheritable factor.

Ayrshire.—The best returns both for the six months and for the winter average were shown by the only record sent in from this county. Twenty White Wyandottes and 20 White Leghorns, the ages of which are not given, laid an average per bird of 46 eggs in the winter and 113 for the six months. This member sent in the individual records of several of her Wyandottes.

Banffshire.—Two flock records were sent in, one for a pen of 26 Leghorns hatched in April, May and June 1920, which laid an average per bird of 36 eggs in the winter months and 99 for the six months.

Another member sent in the monthly totals of a flock of 140 birds for a whole year, the record showing a yearly average of 122 eggs per bird.

Berwickshire.—Two records were received from Institute members in this county. One referred to a pen of 15 White Leghorns which laid an average of 27 eggs for the winter months and 88 eggs for the six months. No eggs were recorded in November and the number of the birds in the flock varied from 11 to 17.

Caithness.—Records were sent in from four members, the best being from a flock of 45 White and Brown Leghorns which laid an average of 15 eggs per bird in the winter and 56 in the six months.

Dumfriesshire.—Ten members from this county sent in record sheets. The best record was from a flock of 15 White Leghorns and crosses which gave a winter average of 26 eggs per bird and a six months' average of 87. No eggs were recorded until 24th November.

East Lothian.—One member sent in five record sheets, the best being from a pen of 31 April and May hatched White Wyandotte pullets which gave a winter average of 38 eggs per bird and a six months' average of 96 eggs.

Fifeshire.—Ten records were submitted. A flock of 16 White Leghorns hatched in April headed the list with a winter average of 36 and a six months' average of 95 eggs per bird.

Forfarshire.—One record sheet was sent in from this county. It shows that a flock of 175 birds of White Leghorns, White Wyandottes, Buff Orpingtons, Rhode Island Reds, Anconas and other breeds, of which half were pullets and half hens, laid an average of 25 eggs per bird in winter and 78 eggs in the six months. A number of the hens were used for hatching purposes.

Inverness-shire.—Members in this county sent in nine record sheets, the best coming from a member who keeps 10 cross-bred hens and 2 to 6 cross-bred ducks. The winter average for the 10 hens was 26 eggs per bird and the average for the six months, 1st November to 30th April inclusive, for the hens and ducks was 67 eggs per bird. No duck eggs are recorded before 1st March.

Kinross-shire.—Of the two records sent in from this county the

honours go to a pen of 30 Wyandottes crossed with Leghorns and hatched at the end of April 1920, which laid an average of 35 eggs per bird in the winter months and 69 for the six months. The pullets are reported to have started to lay in September.

Lanarkshire.—Six records were sent in, the best of which was that of a pen of 120 birds, 80 of which were White Wyandottes and 40 White Leghorns; they laid an average of 33 eggs per bird in the winter months and 102 for the six months.

OBSERVATIONS ON THE RESULTS SHOWN BY THE RECORDS.

One member who evidently traps nests gives the highest individual records in her flock of 40 birds. The best is that of a White Wyandotte which laid 149 eggs in 169 days—i.e. less than six months. The poorest individual record is not given, but we may fairly compare the highest individual record with the lowest flock records as shown by the returns from all districts. One flock of 20 White Leghorns shows an average of 28 eggs for the six months, but no eggs were recorded for November, December and January. Of the flocks that were known to be laying in the winter months the lowest record is an average of 3 eggs per bird for the winter months, no eggs being recorded from 19th November to 10th December, and an average of 35 eggs for the six months from a flock of 26 hens.

Estimating the value of eggs for the three winter months at 4s. per dozen, and for the three spring months at 2s. per dozen, the best flock shows an average return per bird of

15s. 4d. for winter eggs

11s. 2d. for spring eggs

£1, 6s. 6d. for total eggs for six months.

The poorest flock shows an average return per bird of

0s. 0d. for winter eggs

4s. 8d. for spring eggs

4s. 8d. for total eggs for six months.

But a flock record, showing as it does the average of the eggs laid by the whole pen, does not reveal the deepest poverty of the poor-laying hens. It must also be taken into consideration that the institute members who have kept records are naturally those who are most interested in their poultry yards, and it may therefore be presumed that there are many hens in Scotland and even owned by Institute members which lay so few eggs in winter that they must be a source of considerable loss to their owners. On the other hand, it is only fair to add that it is known that many expert women poultry-keepers have not contributed to these returns.

Finally, these records prove the need for, and the possibility of, improving winter egg production in the average poultry flocks, particularly as it has been observed that the flocks which do well in the winter months, whether of sitting or non-sitting breeds, also put up high records for the whole year; so while congratulating

Institute members on the excellent recording work which has been achieved, it is hoped that many will so improve their stocks and management that the records kept next winter will be equally worthy of congratulation.

UNTIL quite recently a good deal of doubt existed in the minds of some as to the causal identity or otherwise of the various manifestations of this disease. In works upon the diseases of poultry *Epithelioma contagiosa* was given a separate chapter altogether from Avian diphtheria. Other names by which the disease is known are chicken-pox, canker and catarrh. Experimental workers knew, however, that by placing healthy fowls amongst the affected one sometimes reproduced the canker type of the disease and sometimes the diphtheritic throat type, and now, since the discovery that each condition is caused by a similar kind of virus, doubts have been swept away.

It must be remembered that all conditions termed roup by poultrymen are not this contagious disease. Some of these are certainly only simple colds to begin with, but with bad after results in the shape of complications in the cavities of the head.

Symptoms.—This contagious disease manifests itself in two forms: (1) on the skin of the bird's head, and (2) on the membrane lining the mouth, throat and nostrils. The two forms may appear at the same time on one bird.

The common form in this country is the occurrence of warty growths on the parts of the head devoid of feathers. A number of small growths may coalesce to form large masses. They occur on the comb, wattles, angles of the mouth and the eyelids. When fully formed the scab comes off and leaves a white pitted area like a pock-mark. Under the microscope these wart-like growths are seen to be due to a great multiplication of the epithelial cells of the skin, and the general structure of the growth is after the style of the tumour known as an epithelioma; hence the name Contagious epithelioma.

The appearance of these lesions on the head is accompanied by other complicating lesions. There may be a discharge from the eyes which dries and glues the lids together, the retained discharge causing damage to, or the total loss of, the eyes. Similarly there may be discharge from the nose and accumulation of the discharge in the cavities of the head. These accumulations lead to distorting swellings of the head, from which comes the name sometimes given of "swelled head."

The other form, probably as common, though less noticeable from the situation of the lesions, is that in which a diphtheritic type of false membrane forms over the lining membrane of the mouth, throat and back of the nostrils. This false membrane may form very quickly over the top end of the windpipe and cause death very suddenly by obstructing the passage of air. It is

¹ Paper read by Professor S. H. Gaiger, F.R.C.V.S., Principal of the Glasgow Veterinary College, at the 6th Annual Poultry Conference of the Harper Adams Agricultural College, August 1921.

called a *false* membrane, because it is not a membrane in the sense in which the term is used of the membranes of the body. It consists merely of coagulated exudate from the true lining membrane of those parts. Such false membranes are spoken of as diphtheritic membranes, from the resemblance to false membranes in the human throat in diphtheria cases. The actual causes, however, of the human and fowl diseases are quite distinct.

Accompanying these external and internal lesions in the fowl there is severe systemic disturbance, as denoted by the rise in temperature, the dull, huddled-up, ruffled appearance of the bird, which also is quite indifferent to persons or surroundings, and may move only when pushed.

The disease may be very acute, killing the bird before any symptoms have been noticed, or the bird may last several days and then die. Chronic cases last several weeks and may recover. Mild cases with slight lesions occur and then recover, and if these lesions are in the mouth the owner may not know that the fowl has passed through an attack.

Mortality seems to depend upon conditions in the flock which becomes infected. Sometimes as many as three-fourths of the flock become visibly affected and half of these may die. Autumn and winter see the disease at its worst.

Causation.—The cause of the disease has been shown to be what is termed a "filterable virus." The meaning of this term is that the virus, whatever it may be, is so small that it will pass under pressure through the pores of a filter candle made of unglazed porcelain. Bacteria are too large for the pores of such a filter and are not to be found in the filtrate, so that a filterable virus is smaller than bacteria which can be seen by the microscope. The filterable viruses, speaking generally, cannot be seen by the microscope.

Filterable viruses of different diseases vary in size, as can be shown by some passing through a filter of fine porosity, whereas others will pass only one of coarse porosity. Those of the latter type are probably only just beyond the range of present-day microscopes, and it is possible, in the case of Avian Diphtheria, that certain bodies known as "cell inclusions" may be the actual causal agent. A great deal has still to be found out about the filterable viruses. All that can be said now about the virus of Avian Diphtheria is that it is a comparatively large filterable virus.

Spread of Infection.—The commonest way by which the disease is spread is by newly purchased fowls carrying the disease to their new quarters. Where no intercommunication between diseased and healthy premises can be traced, it is probable that the outbreak is attributable to the visits of infected pigeons or other free-flying birds.

Once the disease has gained access it readily spreads from fowl to fowl by cohabitation. Probably the habit which the healthy have of pecking the heads of the sick most readily conveys the disease.

Experimentally the disease can be conveyed by almost any manner of inoculation, and by the inoculation of almost any portion of an infected fowl, for the virus seems to be present in all parts of the body and its fluids.

Treatment.—Prevention of infection with this disease is certainly better than its cure. All newly purchased fowls should be regarded with suspicion and placed in two weeks' quarantine to see if they remain healthy during that period, after which they may be placed with the healthy. It must be remembered that some fowls which have passed through a mild attack may act as "carriers" of infection and show no symptom. It follows that they will develop none during the period of quarantine. Therefore the owner would be wise, whenever he puts newly purchased fowls in quarantine, to place one or two of his susceptible fowls in contact with the new arrivals, in order to bring out the infection in the susceptible birds.

The value of curative treatment, once the disease has broken out, is questionable. No doubt many sick birds can be assisted to recover by careful treatment of the lesions, but the owner has to decide for himself whether this procedure is a profitable one. Every sick bird is a possible source of danger to healthy birds. It should be remembered that the virus of the disease can increase in amount only in the body of the fowl or other birds, as pigeons, geese, ducks, turkeys, wild birds, etc., and that to keep affected birds alive is to keep going a factory for the production of virus. On the whole it should be looked upon as inadvisable to treat birds suffering from this disease for that reason alone, but also because of the great ease with which the virus can be conveyed indirectly from the birds in hospital to those in the healthy runs.

The infected should be destroyed and burned or buried deeply. The healthy should be inoculated to prevent infection. The houses should be efficiently disinfected. Disinfection of the houses may be done with 5 per cent. carbolic acid or other disinfectant of proportionate strength, and it must be done thoroughly. If possible the soil should be ploughed up, and in any case it must be limed with unslaked lime.

Preventive inoculation has been practised to a considerable extent by some American workers, but it does not seem to have been taken up in this country. Recently in Glasgow I prepared some vaccine from material supplied from America, and 1000 doses were used in Yorkshire for trial. The vaccine consists of finely powdered scabs, from affected fowls, in suspension in normal salt solution. The virus in this suspension is dead, having been destroyed by heating for an hour at 55° C. The dose is 1 c.c., injected under the skin on the inside of the leg on two occasions at a week's interval. The object of vaccinating is to cause a reaction in the fowl's body and set up immunity against natural infection. It certainly seems worthy of trial in Britain.

THE following notes on the recent census of beekeepers and stocks of bees in Scotland have been supplied by the Rev. John Beveridge,

**Stocks of Bees in
Scotland.**

M.B.E., B.D., Honorary Secretary of the
Scottish Beekeepers' Association:—

During the war the beekeepers of the land suffered great losses from two causes—an epidemic disease among the bees and, following poor seasons, the lack of food to carry the surviving bees through the winter. The natural source

from which bees derive their stores is the nectar from the blossoms of plants, bushes and trees. If the weather is favourable during the summer and autumn months the bees can lay up ample stores of honey for themselves and a good surplus for the beekeeper. The average number of bees in a hive is about 30,000. At the height of summer the number may rise to 60,000 or more; at Christmas it may fall to 15,000 or less. For the six summer months the bees consume on an average about 1 lb. of honey per day, and at the end of summer, when breeding slackens off, the bees must have in store at least 30 lbs. of food to carry them through the winter. That is not a big ration, 1 lb. of food per 1000 bees for the six months when nectar is not to be obtained. But if the season is a poor one, or if the stocks of bees have been induced to swarm too much in the summer, the amount of honey in the hive may not be anything like 30 lbs. In that case the bees may have difficulty in surviving the winter. The only suitable food for bees, apart from honey, is pure cane sugar. And so long as that was available during the war beekeepers did their best to keep their bees well supplied with food.

When, however, the Food Controller rationed the sugar for the country it was impossible for most beekeepers to provide the necessary stores for the bees. Urgent appeals were made to the Government to supply bee sugar on any conditions whatever, but nothing was done the first winter. Only when honey was in demand for the army, and when reports from all parts of the country were received telling of the great mortality of bee stocks due to starvation, were arrangements made whereby beekeepers could obtain sugar to feed their bees. Had it been possible to tell how many beekeepers were in the country and how many hives there were, the probability is that immediate attention would have been made to the appeals. The Scottish Beekeepers' Association therefore resolved to prepare a Register of Beekeepers and Hives. They received valuable encouragement from the Scottish Board of Agriculture, which promised, *inter alia*, a financial grant for the census.

The Scottish Beekeepers' Association has now branches or associates in every Scottish county. But in only half of these counties are there yet associations responsible for the organising of the whole area. Consequently the Registrar who was appointed had to find helpers in the counties or districts where no branches existed, and generally she received very ready and willing assistance. For instance, the Registrar was put in touch with all the District Food Controllers, and in nearly every case these provided lists of the beekeepers who had applied, in their respective areas, for a sugar ration for their bees. Beekeepers applied for rations only for the stocks that were short of food, and consequently the list was known to be incomplete. Then the secretaries of every county and district association were asked to supply authenticated lists of the beekeepers in their area, with the number of stocks they possessed, differentiating between those in frame hives and those in straw skeps. In many cases this was most carefully done, and in these areas the results must be considered as satisfactory as is possible in connection with beekeeping where the number of stocks, by swarming and otherwise, fluctuates greatly

from season to season. Then associate members were invited to supply information for their own districts, and these often enlisted the aid of friends in surrounding areas. In several districts teachers and others, on whom the Association had no claim, were invited to help and rendered very valuable assistance. All these supplemented the lists supplied by the Food Controllers. But there are some districts from which all the returns have not yet been received.

Lists more or less complete have come from every county and some of these have been revised so carefully that it is now possible to issue a provisional report, giving a summary of the returns up to the 31st March 1921. But in perusing the abstract below all due weight must be given to the deficiencies already mentioned. Except in the cases specified in the next paragraph, it is believed that, estimating conservatively, at least 30 per cent. can safely be added to the number of beekeepers and hives.

NUMBER OF BEEKEEPERS AND HIVES IN SCOTLAND, AS
REPORTED UP TO 30TH MARCH 1921.

COUNTY.	Beekeepers.	Hives.	1 Beekeeper per		1 Hive per Acres.
			Square Miles.	No. of Inhabitants.	
†Aberdeen ...	2647	9,380	75	117	134
†Argyll ...	297	997	10	250	1,990
†Ayr ...	404	1,580	27	628	458
Banff ...	130	420	5	470	965
Berwick ...	132	365	35	242	800
Bute ...	125	500	17	144	280
†Caithness ...	225	650	3	155	675
†Clackmannan ...	42	60	13	636	583
Dumbarton ...	150	925	166	800	170
Dumfries ...	222	704	48	327	974
Edinburgh ...	81	276	44	6,049	844
Fife ...	236	752	21	928	431
Forfar ...	217	495	4	1,336	1,118
Haddington ...	6	15	44	6,666	11,400
Inverness ...	488	2,460	8	184	1,095
Kincardine ...	277	1,045	137	112	233
Kinross ...	41	167	2	170	317
†Kirkcudbright ...	293	860	3	135	668
Lanark ...	220	1,030	4	6,300	546
Linlithgow ...	26	110	46	2,154	700
Moray ...	254	900	19	50	338
Nairn ...	140	462	11	100	225
Orkney ...	36	129	10	833	185
Shetland ...	1	1	551	28,000	353,000
†Peebles ...	86	264	4	174	845
†Perth ...	556	1,710	44	221	935
Renfrew ...	147	372	16	1,823	411
Ross ...	296	1,143	105	260	1,730
Roxburgh ...	120	363	55	416	1,205
Selkirk ...	8	28	335	3,125	900
Stirling ...	165	520	27	864	555
Sutherland ...	120	375	169	183	3,461
Wigtown ...	227	593	21	145	525
	8415	27,650	36	656	703

From each of the counties of Haddington and Selkirk only one list has been returned, and doubtless the explanation will be found when the next revision is being made. Meantime we may be confident that the final figures will be very near the average for the rest of the country—viz. Haddington 66 beekeepers with 243 hives, and Selkirk 28 with 243. The number, then, will be practically 8500 beekeepers with 28,070 hives in Scotland. The counties marked with † have had the lists so carefully revised that they may be assumed to be as accurate as can reasonably be expected.

But what are we to say of Shetland, with a single beekeeper and a solitary hive? Careful inquiries were made and not a single stock of domestic bees could be heard of in the islands, and no wild honey bees had been observed either. In 1920 the North of Scotland College of Agriculture came to the conclusion that in Shetland bees might profitably be kept for the pollenising of the blossoms of plants, and also for the production of honey. In the old Shetlandic Sagas honey is referred to in such a way that we must assume that bees did in Shetland produce the honey from which the local mead was made; and if honey was produced then, why not now? Moreover, it is becoming more and more difficult to obtain a pure strain of our native black bee, and it was resolved to send a stock of black bees there for experimental purposes. If it survives and gives a satisfactory return, then other black bees can be placed there, and in due time it may be possible to obtain pure, vigorous queens for requeening stocks in any part of the country. So a teacher from Shetland who was attending the Summer Beekeeping Course at the Aberdeen College was approached by the authorities and undertook the charge of the experimental stock. And in August 1920 the first hive containing bees in modern times was established at Geosetter Bigton in Shetland, and beekeepers all over the country are looking forward with interest to the report of that beekeeping experiment from Ultima Thule at the close of this season.

The number of stocks of bees that may be profitably kept within a definite area has never been established; indeed no reliable figure can be given. What is profit? The man who wants to make a living from bees requires and gets a much larger return from each of his stocks than does the one who leaves the bees to fend for themselves. But the average beekeeper should obtain, on an average of three years, an annual return of at least 25 lbs. of honey. That probably represents 100 per cent. on his capital outlay, not counting anything for his time and work. The expert wants an average of 50 lbs. or more.

The really effective range of bees from their hive is only one mile, although bees do bring in nectar from a two-mile radius, and they have been known to fly five miles out. Taking the two-mile radius, it has been supposed that 50 stocks would not be too many for any except the least fertile districts of the land, and that 200 in a good year in a good district would find ample food for themselves and an adequate return for the owner. But one of the most extensive beekeepers in Scotland, who has upwards of 400 stocks in his home apiary, within ten miles of Glasgow, maintains that even 500 stocks are not too many for a good district in a good year.

The area included in a two-mile radius is about 13 square miles. For 50 stocks, that gives 4 to the square mile, or 1 stock to 160 acres. The only Scottish county, according to our Register, that reaches this is Aberdeenshire, with 1 stock to each 134 acres. Dumbartonshire, with 1 in 170, and Orkney, with 1 in 185, come comparatively near. If these counties are only reasonably stocked, what a tremendous lot of land remains to be taken up in most of the other counties.

The average number of stocks of bees kept by Scottish beekeepers is 3.3, or less than the number that could be kept profitably in the very poorest district on a one-square-mile area. Wherever a square mile of country has no bees, at least 1 cwt. of honey, worth £10 at present value, is being lost to the country.

The proportion of beekeepers to the population of the country greatly varies. Morayshire has one beekeeper to every 50 of the population, Nairn to every 100, Kincardine to 112, Aberdeen 117, Kirkcudbright 135, Bute 144, Wigton 145, and Caithness 155. This means that a very large number of the inhabitants are directly or indirectly interested in beekeeping, and in each of these counties the Education Authority ought to make provision for the instruction of the school children in the principles of practical beekeeping, and for the delivery of lectures for the benefit of those who are not really making the most of their bees, because of ignorance of the best methods of management. On the other hand, the Education Authorities in counties where the beekeepers are much fewer in number than they ought to be should provide facilities for letting children and adults know how easy and profitable beekeeping can be in any part of the country, if only it is engaged in with intelligence. If at least £10 per annum is lost to the country for every square mile where there are no bees, then the counties of Ayr, Argyll, Caithness, Dumfries, Kirkcudbright, Lanark, Peebles and Perth lose between them over £80,000, or an average of £10,000, because there are not sufficient bees or beekeepers. That is the most moderate calculation, on the basis of the number of hives capable of making a profit, on the least fertile land in all the country. There are those who say that the loss is five times that amount; and, if this is so, Scotland is losing not less than one million pounds per year.

When all the lists have been revised and the schedules have been closely examined, there are several other points to which attention might be directed. But meantime the Register which has been prepared provides us for the first time with definite information regarding certain phases of beekeeping which many have been anxious to obtain, and which will be valuable to those who are interested in the real welfare and progress of the industry.

THE Local Government Board for Ireland have issued a report¹ made to them by their bacteriologist, Dr J. W. Bigger, on a bacteriological investigation of Dublin milks and the pure milk problem. The samples investigated were obtained in the usual

¹ To be obtained from H.M. Stationery Office, 23 Forth Street, Edinburgh, price 2s. 7½d., post free.

course of delivery in the city of Dublin over a period from August 1919 to July 1920 and may therefore be taken as fairly representative of the milk customarily purveyed for general consumption.

The first part of the report deals with the actual results of the bacteriological examination of Dublin milks as given in several tables. The results show that there is a general tendency for the figures to be higher in the warmer months of the year than in the cooler, the summer average for total organisms being nearly seven times that of winter. Dealing with the total number of organisms discovered in the milks, as shown by the general results, it is stated that 48 per cent. of the milks tested would in Boston, United States of America, have been pronounced unfit for human food, while in Rochester, New York, only 23 per cent. would have escaped being condemned. It was also noted in the course of the investigation that rail-borne milks generally disclosed a much higher bacterial content than the others examined, especially during the warm months, but considering the long interval that may be assumed to have elapsed between the milking and examination, it is not to be inferred that a markedly lower standard of care and cleanliness is general in country districts. Fifty samples were tested for the presence of tubercle bacilli and positive results were obtained in four instances, thus showing that one milk out of each twelve sold in the city contained living tubercle bacilli, capable of causing tuberculosis in the consumers, especially if these be infants or young children.

The second part of the report gives an interesting comparison of the results of the present investigation with those made in other centres of population, and in this connection reference is made to the recent bacteriological investigation of Edinburgh milk by Cunningham and Thorpe. The comparison shows that while the total number of bacteria in Edinburgh and Dublin milks is about the same, the former contains fewer lactose fermenters and accordingly is probably less contaminated with manure than that of Dublin. The proportion of the milks of various cities found to contain tubercle bacilli is shown in tabular form. In Edinburgh the proportion, on an examination of 406 milks, was 20 per cent.; in Dublin only 50 milks were examined and the proportion was 8 per cent.

The report emphasises that, while temperature and time are factors in causing milk to contain large numbers of bacteria, it is from cow manure, either directly or indirectly, that the majority of the bacteria found in milk come, and that the essential requirement for the production of clean milk is to prevent the access of cow manure to it. In this connection Dr Bigger describes an instructive experiment to test the effect of simple precautions on the purity of milk. These precautions included a thorough washing of the milk pails, cleaning of the udders, teats, belly and legs of the cow, and washing of the milker's hands and arms. As compared with milk obtained by the ordinary methods, the samples gathered under the improved procedure showed a reduction of the average number of total organisms to about one-thirtieth, while the average souring interval was extended threefold. The last-mentioned result is of great importance alike in its

commercial aspect and from the point of view of the householder, and should be regarded as a set-off against the increased cost of production which more careful methods of handling may entail.

Dr Bigger discusses two methods of improving the quality of the public milk supply, suggested by the practice and experience of other countries. A system of grading has been adopted elsewhere, as the result of unofficial or of administrative action, and has aimed at securing a differential marketing of milk based on quality and supported by a guarantee of production under wholesome conditions. This system, it is urged, is practicable in the case of Dublin, and even if the price of milk were required to be raised, it would inflict no hardship, as there would be no waste through souring and infants would thrive better on the pure milk. The introduction of a compulsory bacteriological standard for milk, if involving liability to penalty for non-compliance, is, however, less capable of immediate application. At present the technical machinery authorised by law for the administration of the enactments relating to the sale of food in this country is confined to chemical analysis and does not embrace bacteriological examination. While on general grounds it would seem reasonable that the community, in regard to pure food, might be afforded the protection available from the advance of scientific research, it will be seen that at the present the establishment of an obligatory bacteriological standard applying to the sale of milk is beyond the sphere of administrative action, but is a matter for the consideration of the legislature.

The suggested regulations for a pure milk supply are summarised as follows:—

(1) The herd must be free from tuberculosis, as judged by the tuberculin test. Annual tests must be made and reactors removed.

(2) The physical condition of all cows must be satisfactory on six-monthly veterinary examination.

(3) The cow sheds, milking sheds, and dairy must be suitable, and must be kept thoroughly clean.

(4) The equipment must be of approved design and capable of proper cleaning.

(5) The methods of milking and of dealing with the milk must be open to inspection and must be found satisfactory.

(6) No milk may be more than twenty-four hours old at the time it is sold.

(7) Milk must be cooled immediately after collection and must not be at a higher temperature than 55° C. subsequent to this.

(8) Facilities must be allowed for taking samples of milk for bacteriological and chemical examination.

(9) No milk may contain more than 100,000 bacteria, capable of growing at body temperature, in each cubic centimetre. Lactose fermenting bacilli must not be present in two tubes to each of which has been added $\frac{1}{8}$ c.c. of milk.

THE most noticeable feature of the Women's Institutes' work during the summer months following on the Area Study Meetings has been the great development which is taking place in the organisation of shows and exhibitions in conjunction with local agricultural or horticultural societies. The first Institute exhibit of this nature was held in Fife three years ago, and Lochaber led the way in encouraging displays of school children's work in conjunction with the Rural Institutes. This year combined exhibitions are known to have been held in eleven counties.

The objects of Women's Rural Institutes' Shows and Exhibitions may be briefly summarised as follows:—

(1) To pass on any special knowledge possessed by one Institute for the benefit of others.

(2) To encourage a high standard of excellence in—

(a) Production—*e.g.* in poultry, eggs, honey, vegetables, fruit, etc.

(b) In the utilisation of edible produce—*e.g.* butter, cheese, scones, oatcakes, bottled and dried meat, fruits, vegetables, pickles, etc.

(c) In handiwork—*e.g.* needlecraft in all branches, skin-curing, basket-making, etc.

(3) To provide an opportunity for obtaining advice from competent judges.

(4) To encourage as many members as possible to take part, and so to raise the average standard of excellence.

(5) To foster the community spirit which is so marked a feature of the Institute movement.

The general standard of excellence is often increased when, in connection with Institute competitions, members gaining a prize or several prizes in succession pass into the prize-winners' class and compete with one another and not against non-prize-winners. The show work in connection with an Institute is based on the exhibits and competitions held at the monthly meetings. It is usual to hold an exhibit of all work done locally at a date previous to the county show, and from this exhibits of special excellence are chosen to form the Institute exhibit. The fact that in judging an inter-Institute competition the proportion of members competing is taken into account encourages as many as possible to send forward specimens of their work.

This year judges have in certain cases circulated a condensed report to Institutes exhibiting, with a view to giving guidance in regard to further effort. Papers based on the experience gained up to the present time and containing suggestions for Women's Rural Institutes' Shows and Competitions, and points for judging in the various sections, will be available shortly and may be obtained on application to the Board.

THE weather during June and for the first three weeks of July was dry generally, with some days of extreme heat. At the end of July some rain fell and during August the weather was very broken, rain being frequent and in some instances very heavy, especially

in the central and southern counties. The prolonged drought affected all crops and pasture more or less seriously; but while the rain came too late to be of much benefit to the cereal crops, it has proved of great value to the potato and root crops, and has tended to restore the pastures. The conditions during August were unfavourable for harvest operations throughout the greater part of Scotland, the cutting and ingathering of the cereal crops were delayed and damage was caused owing to exposure to the weather and also by sprouting.

The wheat crop promised earlier to be satisfactory as regards quality, but, as has already been stated, the grain was badly weathered in many districts during August. The cutting of wheat was fairly general during the latter half of August and at the end of the month the work was well advanced in most parts. The present estimates of the yield of grain are fairly satisfactory, an average yield, or slightly over, being expected in the great majority of the districts in which the crop is principally grown; in the Lothians, Roxburgh and Lanark the estimated yield is given as about 5 per cent. below the normal.

The cutting of barley was completed at the end of August in some of the north-eastern districts and was well advanced elsewhere. The estimates of yield are very variable; in many districts an average yield is estimated, but in South-West Fife and the Lothians it is expected that the deficiency will amount to 20 per cent., while in North-East Forfar, South-East Perth, Berwick and Roxburgh the estimates are given as 10 per cent. below the normal.

The reports on the oats crop are on the whole less favourable than in the case of wheat and barley and the yield is expected to be considerably below the normal. In many cases the crop was stunted and in some districts the grain was badly discoloured by rain. Cutting was general during August, except in Orkney and Shetland.

Beans are generally reported to be healthy, but the yield will be below the average and the straw short. In Berwick the crop has not podded well and in Roxburgh it is very thin and irregular.

Potatoes were checked severely by the drought and in many cases the yield of earlies was exceptionally low. The later varieties, however, have benefited very much from the rain that has fallen since the end of July and the crop prospects are now more favourable. Yields very considerably below the normal are, however, expected in South-East and Central Perth and the Lothians, while in Fife, Roxburgh, South-East Lanark, South Ayr and Dumfries the estimated deficiency is 10 per cent. Complaints of disease have been received from Roxburgh, Stirling, North Argyll, Lewis and Orkney, while second growth among early varieties is reported from several districts.

Turnips and swedes have also improved greatly since the beginning of August, but many late-sown fields are thin and irregular. The yield will be somewhat below the normal in the Lothians, North-East Fife and Roxburgh; in South-West Fife the deficiency is estimated at 30 per cent. and in Berwick at as much as 40 per cent. Mangolds have recently made satisfactory

progress and now promise to be a fair crop, especially in the south-western counties.

Small fruit were a lighter crop than usual, and owing to the abnormal rainfall and lack of sunshine did not develop satisfactorily. Apples are a fair crop in some cases, but plums are practically a failure in most parts.

Pastures improved greatly during August and all classes of live stock have made satisfactory progress. Dairy cows are reported to be healthy, but the milk yield has fallen off in some districts, and in others extra feeding has been needed in order to maintain the supply. Sheep and lambs are generally reported to be thriving, but in some districts the hill lambs are not so well grown as at this period last year.

The supply of regular workers is generally adequate, but skilled horsemen are scarce in South Ayr and Dumfries and dairy workers are short of requirements in Renfrew. Casual labour is also plentiful and in some districts is reported to be in excess of the demand.

RECENT PERIODICAL LITERATURE.

The majority of the following extracts and summaries are taken from recent bulletins of the International Institute of Agriculture. Full references to the bulletins, and to the original publications quoted therein, may be obtained on application to the Secretary, Board of Agriculture for Scotland, 29 St Andrew Square, Edinburgh.

Topping of Wheat liable to Lodging. (1) Schribaux, (2) Bachelier, *Comptes rendus de l'Académie d'Agriculture de France*.—(1) M. Schribaux describes a definite means not only of dealing with lodging, but for utilising the vigour of growth of wheat to increase the grain yield at the expense of the straw yield.

When the wheat shows signs of bearing and measures about 30 cm. it is sufficient to cut back to 15 cm.—i.e. to half its normal height. When the plant again reaches a height of 20 cm. it is advisable to cut back a second time to 15 cm. if it still appears liable to lodging: this second treatment is hardly ever necessary. By this means the entire wheat crop is rendered resistant to lodging, whatever the height, and 30 and 15 cm. are the recognised figures which it is wise to observe as nearly as possible. If the wheat obviously exceeded 20 cm. in height, one must take the risk of topping, anyhow to a small extent, the young ears, which are still enclosed in the sheath.

The practice of topping, first pointed out by M. Hanicotte, farmer and former President of the Syndicate of Agricultural Distillers in the North, is at the present time a generally recognised procedure on the best farms in the north of France. On small areas the wheat is cut with the scythe or sickle; in the neighbourhood of Paris a header is employed, which is a kind of very light sickle with a blade which can be lifted to at least 15 cm. This same implement, manufactured by Garnier, at Mormant (Seine-et-Marne), is also used for destroying weeds amongst the wheat.

Topping delays ripening for some days and somewhat reduces the straw yield, but, on the other hand, the quantity and quality of the grain yield is improved. A field thus treated gave the lowest proportion of dwarfed wheat. The cause is easily explicable: the topping which can be compared to the pinching practised by gardeners has the effect of equalising the development of the tillers. The more advanced are retarded in growth to the advantage of the smaller ones, not reached with the sickle; the latter, which would have given only small tiller growths, take the same time to mature as the older ones.

In order to show the various advantages of topping, M. Schribaux gives a brief *résumé* of a paper read some time ago (1909) before the National Agricultural Society by M. Bachelier. M. Bachelier had cut back wheat covering an area of 61.75 acres sown after alfalfa, leaving a control plot of 32.8 ft. untouched for comparison purposes. In the area treated, M. Bachelier obtained an increased yield of 733 kg. of grain and a decreased yield of 600 kg. of straw per hectare.

What expenses are entailed by this operation? The machine used cost 450 fr. (pre-war price). The cost of upkeep is negligible, as the blade is held too far away from the soil to encounter obstacles (14 fr. for upkeep in seven years). An area of 9.8 acres can be covered in a day by a man and a horse. The cost per acre may be estimated thus:

Manual labour and horse	..	..	1.00 fr.
Depreciation and upkeep of machine	..	..	0.60 „
			1.60 fr.

This expense, plus the value of at least 13.7 cwts. of hay, is largely compensated for by the decrease in the cost of harvesting and the superior quality of the produce.

The idea of topping is almost as old as the cultivation of wheat, but M. Hanicotte has the merit for having perfected it.

This method is equally successful with oats, but the operation is not so easy as with wheat. As oats grow very quickly, the time allowed for performing this operation is very limited. By delaying the treatment there is a risk of letting the plant get too tall, and of injuring the panicle still enclosed in the sheath, and consequently of damaging the production of grain.

(2) M. Bachelier considers that there is no reason to fear that, even in case of drought, topping will damage the crop yield.

In order to apply this process to hardy wheats, it is absolutely necessary to choose the right moment when the upper part of the leaves can be clipped without touching the stalk. The whole success of the operation depends on this precaution.

With the "Garnier" implement it is possible to cut back 9.8 acres per day. It consists of a kind of shears with a detachable blade which can be regulated to the height of the wheat. This blade is lighter than that of a mower. It is necessary to work quickly, as the period when it is possible to cut back wheat is very limited. Topping slightly reduces the height of the stalks and makes the plant resistant to lodging.

Treatment with Dry Copper Carbonate for Prevention of Wheat Smut.
G. P. Darnell-Smith and H. Ross, *Agric. Gaz. of New South Wales*.—Years ago laboratory and field experiments led the authors to the conclusion that the copper sulphate solution in which wheat seeds are immersed in order to prevent smut from appearing is clearly injurious, not only to grains that are split or otherwise damaged, but also to healthy seeds, by retarding and, in certain cases, even preventing germination.

After the seed had been treated with the copper sulphate solution, the advice used to be given to immerse it again in lime-water made from freshly burnt lime, so as to neutralise the acidity of the copper sulphate. As regards this, the authors think that, apart from the corrosive action of the copper sulphate, simply immersing the wheat in water is more or less harmful to the future plant. For example, if a bushel of wheat is immersed in water for three minutes it requires eight to twelve hours to dry. During this period partial germination takes place, and if the grain is not sown at once in damp ground so that germination may continue, the swollen grains are stopped germinating, and when a second germination takes place some weeks later, when the conditions are again favourable, growth cannot be as healthy and vigorous as if the grains had not begun to germinate once before.

With the object of eliminating the use of water and of finding a less harmful fungicide than copper sulphate, the authors have carried out many experiments of recent years and have been led to prefer copper carbonate to all the different dusting powders or gases that have been tried. Copper

carbonate, besides being a perfect fungicide, is innocuous to the seed and has the advantage that it can be used in the dry state.

The method finally adopted for treating wheat seeds consists in powdering the seed with dry copper carbonate. It was found to be essential to cover the seed completely with the copper carbonate powder, which can be better done by using a machine that mixes the wheat and copper carbonate together more intimately than by doing it by hand.

The results of cultural tests made in 1917 and 1918 at the Wagga and Cowra Experimental Farms (New South Wales) showed an actual marked increase in the yield per acre in the cases where the new copper carbonate treatment was substituted for the old method of using a bath of copper sulphate. This increase is positive and, in certain cases, amounts to 100 per cent.

The advantages derived from the use of copper carbonate instead of copper sulphate can be summarised as follows:—

- (1) No water is used.
- (2) There is no injurious action on either seed or young plant such as occurs with copper sulphate.
- (3) Seed wheat can even be treated several weeks before sowing.
- (4) No harm comes to the seed if it remains on a dry soil for several weeks without germinating.
- (5) Better germination is obtained.
- (6) This method is quicker and less laborious than using copper sulphate solution.
- (7) A better product is obtained.
- (8) The total quantity of seed grain required for sowing can be treated when the farmer can best spare the time and not necessarily a day or two before sowing.

Experiments in Sowing Barley, made from 1909 to 1915 in Denmark.

R. Iversen, Copenhagen.—Experiments were carried out to determine the influence exercised by the quantity of seed and the method of sowing on the yield of barley and on lodging. The idea was to compare broadcast sowing with sowing 10 to 20 cm. between the lines, with different quantities of seed, limited to from 76 to 180 kg. per hectare. These experiments lasted seven years, 1909 to 1915, at four Danish Agricultural Stations (Lingby, Tystofte, Askov and Lemmerk). The barley employed was a local variety (Tystofte Prentice), Archer type. Cultures were made in sixfold and tenfold plots, as a rotation crop following forage crops or legumes, and well manured. The yield in grain and straw was determined in hectolitres and also the size of the grain; a valuation scale was used for the amount liable to lodging (1 to 10).

From the results, it can be concluded that the seed sown broadcast gives nearly the same amount, quantity and quality as that sown on the 10 cm. between the lines system.

The more important factor would be not so much the manner of sowing as the quantity of seed employed: it is this factor which determines the different possibilities of development in cultivation and prospective yield. It should also be noted that seed sown on the 20 cm. between the line system produces, on an average, 1 quintal of grain less per hectare than in the lines 10 cm. apart.

As to the weight and the size of the grains, they increase when the quantity of seed employed decreases. Experiments appear to indicate that in employing relatively small quantities of seed, lodging can in limited areas be obviated. However, that has no value in practical farm work, considering the quantity of seed which it is necessary to use in agricultural practice.

New Contributions to the Study of Lactic Silages. *C. Gorini, Milan.*

—Investigations made in the United States and in England have confirmed the conclusions arrived at by the author as the result of a long series of experiments upon silaged fodder. He found that it was impossible to dispense with the action of bacteria, hence it was necessary that lactic ferments should preponderate, in order to preserve the silage against harmful and destructive fermentation.

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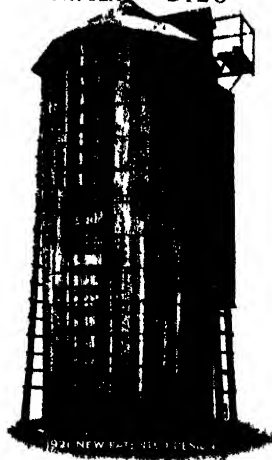
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Inset 1 (Top Left): SUTTON'S PLANT BREEDING RESEARCH STATION SHOWING PEDIGREE PLANTS PROTECTED FROM INOCULATION WHILE GROWING FOR SEED

Inset 2 (Middle Left): CHEMICAL LABORATORY WHERE ROOTS ARE TESTED FOR FEEDING VALUE ETC

Inset 3 (Middle Right): SELECTING THE STOCK ROOTS FOR SEED PRODUCE

Inset 4 (Bottom Left): ONE OF THE SEED TESTING LABORATORIES

Inset 5 (Bottom Right): A FINE CROP OF SUTTONS PRIZE-WINNER MANGOLD

In the article quoted the author refers to the work of Swiss investigators, who have reached the same conclusion (*Schweizerische Milchzeitung*, 1917, Nos. 51 and 94; Burri, R., *Ibidem*, 1918, Nos. 57, 58 and 61; 1919, Nos. 72 and 75; Burri, R., Staub, W., and Hohl, J., *Ibid.*, Nos. 78 to 83).

Of late years there has been a strong movement in Switzerland in favour of the silaging fodders. The "Herba" Co. has been established at Rapperswil for the object of exploiting a special patent mechanical pressure silo with cover, devised by MM. J. A. Sonderegger and A. Mesmer. This system would ensure the success of sweet or, as the author terms them, lactic silages by preventing the troubles arising from the use of acid silages, called butyric by the writer from the predominant bacterial flora.

The use of silage has, however, evoked the protests of cheese manufacturers, who complain that it is impossible to make normal cheese from the milk of cows fed on these fodders. (The same thing occurred in Italy, and it is these objections that have determined and guided the author's researches since 1903.) The question was investigated by the Federal Dairy and Bacteriological Establishment at Liebefeld, near Berne, and the results obtained coincided with those previously published by the author—namely, (1) failure in making good cheese from the milk of cows fed on silaged fodders is not due to the ordinary gas-producing members of the *B. Coli aerogenes* group (the agents causing swelling in cheeses), but to the presence of butyric ferments; in fact these bacteria were found both in the silage and in the milk of the cows to which it was fed; (2) these harmful micro-organisms (this according to the author is the most important result of his investigations) are not only to be found in spoilt or badly made (that is to say, abnormal) silage, or in acid (butyric) silage, but also in the best silage which appears perfectly normal and sweet. As the author has shown, the presence of butyric ferments may be prevented by half-drying the fodder, and by limiting the fermentation temperature. If this is below 50° C., lactic fermentation predominates, and if the temperature is raised to 70° C., as was formerly the custom, the silage is almost sterile; the most dangerous temperature is between 50° and 60° C., because it destroys the lactic ferments, but has no effect upon the butyric ones.

In his recent experiments the author found butyric ferments even in masses of half-dried silage, when the fermentation temperature had been between 30° and 40° C., and the silo provided with an impermeable cover. In this case too much reliance had been placed in the perfect working of the cover, and in the antibacterial action of the carbonic acid produced by cellular respiration, and therefore a pressure of from 2-3 quintals per sq. metre had been considered sufficient, whereas it appears from the author's investigations, and from practical experience, that a pressure of 10 quintals per sq. metre is necessary. But even if every technical precaution is taken to promote natural lactic fermentation, it is not always possible to ensure a sufficient degree of it, or its permanence. Butyric ferments persist surreptitiously, and may become predominant if, for example, the silage is left for some time on carts, or piled up near the cowshed. In order to avoid this hidden danger in cheese-making, it is advisable to use selected ferments rather than antiseptics or ordinary salt (which in given quantities hinders the growth of butyric ferments, but not that of the lactic ones). This has been advised and urged by the author since 1906, and is at present practised in France, Germany, the United States, and even in Switzerland, where the "Herba" Co. has patented a special method of inoculating with selected ferments.

With regard to the choice of the latter, it is necessary, in the first place, to use those lactic ferments which do not attack lactose so readily as the sugars most commonly present in fodders (saccharose, pentose, etc.); in the second place, their proteolytic properties must also be taken into consideration in order at the same time to obtain a useful transformation of the albuminoids.

Practical Value of Entomology. W. Downes, *Jour. B.C. Dept. Agr.*—Some striking figures are given of the losses caused by insect pests in Canada. The author tells us that 10 per cent. of the entire crop of wheat in Victoria is destroyed by the ravages of Hessian fly; that approximately 1,600,000 acres in Alberta, 500,000 in Manitoba and 358,000 in Saskatchewan

were infested by grasshoppers; that vegetables suffer 15 to 20 per cent. average loss from miscellaneous insect pests; that 10 to 25 per cent. loss occurs in orchards owing to the presence of the Codling moth, even in spite of spraying. In forests, he says, insects do more damage than fires. He puts the total annual loss in field crops in Canada at £25,000,000. All these figures show that the entomologists have their work cut out for them, but they give no indication of the practical value of the science. Perhaps figures are less easy to come by in that respect, but the author tells of the control methods employed in British Columbia and of the excellent results that have been obtained. He mentions that grasshopper control alone saved crops to the value of £500,000 in Saskatchewan.

A Natural Enemy of Leather-Jacket Grubs. *J. Rennie and Christina H. Sutherland, Parasitology.*—It is probable that, in spite of the inventions of man, nature's agents are, even yet, the more effective in keeping within bounds the increase of crane-flies and their "leather-jacket" grubs. To the list of natural enemies, such as rooks and starlings, the authors, with the aid of grants from the Board of Agriculture for Scotland, have been able to add a less conspicuous but important foe. This is the grub of a minute, two-winged fly, *Bucentes geniculata*. It lives within the body of the leather-jacket, attaching itself to the respiratory apparatus, and feeding upon the juices of its host. Patient observation seems to show that the parasites enter the leather-jackets in the autumn, when the latter are young, that they pass the winter within their hosts, boring their way way out, and killing their hosts incidentally, in the spring, when they pupate in the soil. Adult flies emerge from the pupæ in April and May, and after a summer cycle another brood emerges in late July. The economic significance of the life history which the authors have unravelled lies, first, in the fact that the parasite eventually kills the leather-jacket grub, and, secondly, in the relative abundance of infestation. In three different districts in Aberdeenshire there were found to be, at particular seasons, infections ranging up to 34.2, 38.6 and 40.0 per cent. This means an enormous slaughter of leather-jackets, and could *Bucentes* be artificially reared and placed in bad leather-jacket areas less might be heard of the leather-jacket plague.

Logan Beetle Control. *A. H. Lees and G. S. Peren, Ann. Rep. Agr. and Hort. Res. St., Long Ashton, Bristol.*—The beetles, *Byturus tomentosus*, lay their eggs in the newly opened flower of the logan-berry, and the larvæ bore into the core of the fruit, the size and shape of which they destroy. Spraying at various stages of blossoming was tried, a spray of 6 lbs. lead arsenate, 10 lbs. soft soap and 100 galls. water being applied at a pressure of 125 lbs. per square inch. As a result, infestation by the beetle larvæ was reduced from 24 per cent. to 15 per cent.

Experiments on the Improvement of Peaty Soil, by Means of Sand, in Denmark. *J. Hansen, Copenhagen.*—Experiments were carried out from 1899 to 1916 at the Agricultural Station at Askov, in conformity with the resolution passed at the Agricultural Congress of Copenhagen in 1888, in order to study the effect of covering a typical super-aquatic peat soil some 10 to 18 feet deep with a layer of mineral soil. The improvement was begun in 1899, and in 1902 three series of plots were marked out in eight fields each 700 sq. metres in area. One plot was given a dressing of sand 5.2 cm. thick, the second a dressing of sand 10.4 cm. thick, and the third acted as a control. Later on the sand was incorporated into the peat by ploughing. The crop rotation after 1906 was: (1) rye; (2) leguminosæ (peas and beans); (3) root crops (potatoes, mangolds and turnips); (4) oats with clover and fodder grasses; (5-8) clover and fodder grasses.

The effects of improving the soil with sand varied during the experimental period. At first the yield of rye, potatoes, mangolds, turnips and, up to a certain point, oats diminished considerably. But afterwards, except in the case of potatoes, the crops were heavier on the soil improved with sand than on the untreated peat land. The averages of all the experiments show that, as a matter of fact, rye is not influenced by the sand, while potatoes yield the maximum crop in the untreated soil and the minimum crop in the soil that receives most sand. Mangolds and

turnips give a slightly decreased crop in the sanded land, but the yield in dry matter is approximately the same as that on the untreated soil. Oats yield more grain and less straw on the sanded than on the untreated land, the quantity of sand used having little or no influence. On the contrary, the leguminous plants and fodder grasses usually gave a constant increase of yield with an increase in the amount of sand applied. If the results of the rotation employed are calculated in "forage units" (1 forage unit = 1 kg. of grain, 1 kg. of dry matter from root crops, 2.5 kg. of hay, or 5 kg. of straw), the annual yield per hectare would be—

2540	forage units on the land without sand
2882	" " " " with 5.2 cm. of sand
3011	" " " " with 10.4 cm. of sand

Manuring experiments carried out with the following amounts (in quintals per hectare and per year):—(1) 45.3 farmyard manure + 4.53 kainit + 0.91 basic slag; (2) 5.89 kainit + 1.81 basic slag + 1.36 nitrate of soda; (3) 8.84 kainit + 2.72 basic slag + 1.36 nitrate of soda—would give, with the rotation quoted above, the following respective numbers of forage units per hectare:—(1) 2607; (2) 2820; (3) 3006.

Sulphuric Acid and Fertilisers. *Baumann, Chemiker Zeitung.*—The present scarcity of the raw materials required by the chemical industry naturally gives rise to restrictive measures, so that the riches of the soil have to be used with more foresight now than before the war. A typical example of this is afforded by the sulphur and pyrites employed in the manufacture of sulphuric acid. The author has devoted his attention to the use of sulphuric acid in the production of the two main classes of chemical products—viz. phosphatic and nitrogenous compounds. On the occasion of the celebration of the 25th Anniversary of the Union of German Fertiliser Manufacturers, on 26th January 1905, attention had already been called to the great problem, still unsolved, of the fertiliser industry and the dry treatment of phosphates without acids with a view to rendering them more available. Although the full economic importance of the question was not then realised, nevertheless experiments were undertaken for the purpose of partially, or wholly, eliminating the use of sulphuric acid in the phosphatic fertiliser industry.

The world production of sulphuric acid is approximately five million tons. The consumption of sulphuric acid in the manufacture of superphosphate is three million tons and in the making of sulphate of ammonia 793,000 tons. Thus three-fourths of the world production of sulphuric acid is completely lost in the soil, when either superphosphate or sulphate of ammonia are used, and at the present moment we have no right to waste such an enormous quantity of sulphuric acid.

The Preservation of Liquid Manure. *R. K. Kristensen, Copenhagen.*—The Danish State Agricultural Experiment Station at Askov has carried out experiments on the preservation of liquid manure by adding sulphuric acid or superphosphate.

The liquid manure used contained 0.478 per cent. of nitrogen, of which 0.418 per cent. was present as ammonia. It was placed in porcelain dishes and evaporated on a water-bath; a series of 5 cc. samples was treated with from 0 to 32.5 cc. of decinormal sulphuric acid and with from 0.1 to 1.5 gm. of 18 per cent. superphosphate.

The results obtained showed that two-thirds of the acid used was retained by the ammonia, and the rest by the other bases. Very small quantities of acid had practically no effect on the conservation of the ammonia; in order to fix all that contained in the 5 cc. sample, 1.3 gm. of superphosphate or 22.5 cc. of decinormal sulphuric acid was required.

The Escutcheon of Dairy Cows. *J. J. Hooper, Breeders' Gazette, Chicago.*—Short discussion on the shape of the escutcheon of 1019 dairy cattle examined by the author and J. W. Whitehouse at the Kentucky Agricultural Station. They found that the "Flandrine" type of Guénon is dominant in the Holsteins (66 per cent.), Guernseys (54 per cent.), Kerry (68 per cent.) and in the few Ayrshires examined (92 per cent.), whilst the

"Selvedge" type was commoner in the Jersey (40 per cent.). The average of the yields of registered Jersey cows shows that cows with a shape of escutcheon theoretically corresponding to a lower milk yield, whether of the "Flandrine" or "Selvedge" type, give more milk and butter than cows with an escutcheon theoretically of the first class of the corresponding type. The author concludes that the escutcheon is more or less a characteristic of the breed and that its size and shape are of little if any importance in selecting dairy cattle.

Relative Anti-scorbutic Value of Fresh, Dried and Heated Milk. *E. R. Barnes and E. M. Hume, Biochemical Jour.*—Raw cow's milk is one of the poorest of foods from the anti-scorbutic point of view. Thus, whereas 1.5 to 10 gm. of various raw fruits and vegetables suffices to prevent the appearance of scurvy in the guinea-pig fed on a diet free from other anti-scorbutic foods, from 100 to 150 gm. of raw cow's milk is necessary to obtain the same result. It has been suggested, based on theoretical grounds, that dried milk should have a still lower anti-scorbutic value than raw milk, while many medical experts state that dried milk is a satisfactory substitute for fresh milk as the sole food for children, with no danger of scurvy from its use. The authors set out to investigate the problem experimentally and have made the following observations:—

Guinea-pigs kept on a diet of oats, bran and milk showed no signs of scurvy; they did show signs, however, when the milk was replaced by an equivalent quantity of dried milk, whether recently made (1 or 2 weeks) or not freshly made (1 to 6 months).

In experiments on monkeys scurvy was prevented by the use of raw milk and of milk brought rapidly to boiling point, then immediately cooled, but it was not prevented when dried milk was used.

Drying deprives milk of none of its efficacy as a growth-promoting food.

Cow's milk produced in summer is of greater value against scurvy than that produced in winter. This is because of the difference of feeding between the two seasons: grass in the former, oilcake, hay, cereals and roots in the second. Feeding with swedes and turnips, on the contrary to feeding with mangels, apparently gives a milk of somewhat higher anti-scorbutic value.

In consequence, when children are fed with dried milk they should be given some anti-scorbutic food as well; the raw juice of oranges, swedes and tomatoes are particularly useful in this respect.

Maintenance and Reproduction with a Diet of Grains and Grain Products.—*E. B. Hart and H. Steenbock, Jour. of Biological Chem., Baltimore.*—Rats and pigs were used in maintenance experiments on adult animals fed solely with cereal grains (wheat, maize, barley) or their products. For experiments on reproduction swine were used which had grown up on any normal ration and which were subsequently fed with: (1) maize alone, barley alone or oats alone; (2) a mixture of maize and oats; (3) maize gluten feed; (4) maize + oats + middlings + oil meal; (5) barley + 2.5 per cent. of wheat gluten; (6) oats + oil meal. All the rations were given with drinking water, and all save the fourth were given with a little common salt at the rate of 1 per cent.

The results, given in charts, show that adult animals can be maintained with grains and their products, plus water and salt, for a considerable time, but complete nutrition with these rations is impossible and after a time a decline inevitably sets in.

When such rations are given to sows they cause the young to die at a rate that increases with the time. The first litter may be fairly successful, but in succeeding litters more and more young are still-born. This bad nutrition is primarily due to inadequate supplies of mineral matter and ultimately to the lack of coarse food and to an inadequate mixture of vitamins. In fact pigs were successfully reared on a ration consisting of oil meal gluten feed and a suitable mixture of salts. With grains such as oats and barley the lack of fat-soluble vitamins may be of greater importance than in the case of yellow maize meal.

Stubbornness: a Note on Equine Pathology. *G. Bianchi, Italy.*—The classic definition of stubbornness is the sudden stoppage of the animal with-

out apparent cause in the middle of a road, while neither kindness nor punishment can make it budge. Stubbornness, however, may assume many other forms, such as a refusal to start when harnessed, or to start again after a stoppage, etc. It is a rehibitory vice in contracts for the sale of horses and is usually ascribed to bad temper.

Professor Bassi has collected an enormous number of cases of madness and intractability in the horse due to cranial asymmetry. The author thinks that stubbornness and the phobias of the horse in general are, similarly, due to a pathological state of the vaso-motor system. In certain horses either work, their first movements or some other cause makes the circulation more brisk, and sight becomes dim and finally disappears; the horse stops, trembles and is afraid to move forward until, when the circulation becomes normal, it loses its fear and starts work again. This explanation is confirmed by the fact observed by the author that 80 per cent. of the horses afflicted with stubbornness have deficient sight; when the ophthalmia is cured the stubbornness disappears.

Protection of Tractors against Freezing. *G. Passelègue, Jour. d'Agric. Pratique, Paris.*—Serious accidents, such as cracked radiators or cracked water-jackets of the cylinders—accidents that not only mean expensive repairs, but make the machine unusable for some time—are caused by the freezing of the cooling water of tractor or automobile engines.

The simplest way to avoid this is to empty the radiator each time that it freezes or threatens to freeze, provided that there is no doubt about it.

It has been suggested that the freezing point should be lowered by mixing the radiator water with chemicals like glycerin, methyl alcohol and calcium chloride. Glycerin has the disadvantage of fouling the radiator tubes and pump and diminishing the cooling power of the radiator. Methyl alcohol gradually evaporates, as it boils at 80° C. Calcium chloride, which gives the best results, used at the rate of 220 gm. per litre of water, lowers the freezing point to -10° C.

The engineer, M. F. Cesbron, of 37 Rue de Brissac, Angers (Maine-et-Loire), has invented an apparatus called the Frigon, which automatically empties the radiator before the water freezes. The apparatus, which is quite small (14.5 × 10.4 cm.), communicates with the radiator at its lowest point by a junction which opens into a chamber, closed at its lower end by a valve kept tight on its seating by a spring pulling on a lever.

The apparatus includes a copper coil with an internal diameter of 4 mm.; the lower end of the coil is closed by a piston whose shoulder rests on the lever already mentioned.

To put the machine ready for action the coil should be well cooled. As the temperature of the air falls the water in the coil, on account of its small volume (5 cc.) and the great conductivity of the copper wall, cools more rapidly than the radiator, so that the water in the coil is frozen while that in the radiator is still liquid. The increase in volume due to the water freezing in the coil pushes the piston, which, acting on the lever, opens the valve and thus empties the radiator.

Experiments carried out by M. Ringelmann at the Station d'Essais de Machines have shown that the apparatus works when the radiator water is still at 3° C. The water freezing in the coil moves the piston a distance of from 2-4 mm. The apparatus, placed on the radiator of a 17 h.p. Mors automobile, emptied all the water that could be emptied by the waste tap before it was frozen.

To provide for the safety of pumps, tanks, etc., that might be injured by freezing, this apparatus, which when placed in position requires no further attention, could be used.

Safety Butteris for Paring Horses' Hoofs. *H. Ayme, Jour. d'Agric. Pratique, Paris.*—This is a very useful little device and should replace the butteris that has been used since time immemorial by farriers for paring horses' hoofs.

The very primitive tool now used has serious disadvantages and must be used most carefully or it is liable to wound either the horse or the man holding the horse's foot; it is difficult to sharpen, as the raised edges make it impossible to sharpen the inner part with the ordinary grindstone. Struck by these defects, M. Etienne, a farrier of Isle-sur-Sorgue (Vaucluse)

has invented a butteris which has the following advantages over the old type. The blade can be removed and can therefore be sharpened quite easily on any grindstone; the front part of the tool is rounded so that there is no danger of wounding either the man holding the foot or the horse being shod. The blade acts like a plane with the difference that the bevelled side is on top. The blade is held in a bronze frame and is fixed in place by a screw nut tightened up by a wing bolt; as the screw slips in a groove, the blade can be adjusted to project more or less, and, in spite of wear, the cutting edge can always be kept in the right place.

The Control of External Parasites of Poultry. *La Vie Agricole et Rurale, Paris.*—The destruction of ticks on poultry is, if not difficult, at least a lengthy process. They have to be dealt with one by one, either by pulling them away, which always causes a nasty little wound, by touching them with a brush soaked in paraffin, or by cutting them in two as near to the head as possible, using curved scissors.

Of the many methods used to free poultry from harmful vermin, only two are both efficacious and capable of being used by anyone. These methods consist in soaking the feathers with paraffin and using a bath of potassium pentasulphide.

All the so-called insecticidal powders are only effective when freshly prepared, which is rarely the case. They are also defective in that they do not adhere either to feathers or skin, so that the birds get rid of them almost at once. A certain adherence can, however, be obtained if the plumage is wetted with soapy water before applying the powder.

Painting the inner face of the feathers with a small brush soaked with paraffin gives excellent results. Care should be taken not to touch the skin with the paraffin, as it causes a slight irritation.

In more serious cases, in which the poultry are covered with mites, lice and ticks, a more radical treatment is required, which is quite harmless. Potassium pentasulphide is dissolved in boiling water at the rate of 30 gm. per litre of water. When the solution has cooled to 30° C., the bird is entirely immersed, except the head, for one minute. The solution should not touch the eyes; therefore the head feathers should be wetted with the finger or a brush. Afterwards the feathers are drained by pressing them lightly, then the bird is placed on thick litter sheltered from cold, draughts and sunshine.

Parasites sometimes cause eye troubles, and in this case the eyes are treated with 3 per cent. copper sulphate solution, or by washing the eyes with tepid boric acid water, and drops twice a day of silver nitrate solution made up of 0.25 gm., silver nitrate to 100 gm. of distilled water.

Trial of a System consisting in keeping Two Queens in Each Hive. *F. W. Sladen, Agric. Gaz. of Canada.*—As it would be of great utility to find an efficacious method for preventing swarming without too much work, the author tried to solve the problem by keeping two queens in each hive for eleven months of the year. He found that this is a practical method.

Two young queens, separated by a double partition of wire gauze, were wintered in a hive in a cellar from 1917-1918. When the dandelion flowered the bees and queen from one side of the gauze were removed to another hive; in this way swarming was avoided and the two queens gave a uniform and increasing production of young bees, thanks to which two strong hives were obtained in time for the flowering of the clover. The number of bees was much greater than the number which began the season with one queen. These bees yielded 480 lbs. of honey.

In order to avoid swarming when the clover flowers, and to obtain two queens again in each hive (all the following operations were carried out in several colonies), the author removed the old queen from the brood chamber when the clover flowered and, eight days later, destroyed all the royal cells save two, one on each side of the metal gauze. A special porch fixed in front of the hive separated the entrances to each half by eight inches. This was done to avoid the possibility that the queens leaving their cells might meet on returning from their nuptial flight. These hives did not swarm.

Ants as Enemies of Bees and Hives. *J. Tinayre, L'Apiculteur, Paris.*—Most treatises on apiculture suggest that ants are more a nuisance than

harmful to bees. The author, however, has found that hives placed near woods are exposed to dangerous invasions by ants, especially in early spring. Unless closely watched, the ants, starved after their winter seclusion, will impoverish the hives in numbers and food.

It is difficult to deal with ants when the hives are near a wood, for as soon as one ant-heap is destroyed another is formed. They can, however, be opened with a pick and burnt out with paraffin. In addition, the base of the supports of the hives should be surrounded by fine wood ashes, as ants cannot climb up this; the ashes should be renewed after the slightest rain.

Observations on the Formation of Sex in Bees. *I. Devauchelle; II. E. Decondré, L'Apiculteur.*—Observations disproving the theory according to which the queen-bee lays only fertilised eggs, and that it is the working-bees who determine the sex, and confirming the theory of Dzierzon, according to which the queen-bee lays fertilised eggs from which are derived working-bees and females (according to the food given by the working-bees), and unfertilised eggs, from which only males can be derived. The unfertilised eggs of humble-bee queens can only give false drones.

I.—Experiments showing that, in a hive deprived of its queen, 4 maternal cells in the breeding cells of males can give males.

If, in this abnormal case of maternal breeding in breeding cells of drones, the eggs had been fertilised, the bees of a colony which was normal would have infallibly bred young females. And if the attendant bees determine the sex, how, when they had such need of replacing the suppressed queen, could they only breed drones with eggs laid in big cells?

II.—Experiments showing that it is sufficient, at the end of the summer, as soon as the breeding of false drones and the false drones themselves have ceased to exist in the hive, to suppress suddenly the queen-bee of a hive possessing only breeding cells of working-bees, and that the attendant bees can indeed bring up females, but that it will be impossible for them to transform the eggs or the breeding cells of working-bees into false drones.

Methods for Heightening the Colouring of Fruit. *A. Truelle, La Vie Agricole et rurale, Paris.*—Colour counts for a great deal in the market value of fruit, which has to satisfy the consumer not only in taste but also in appearance.

It is admitted that the red colour develops by preference in sunlight, and when there are frequent alternations of warmth in the daytime and cooling off at night, as is generally the case in autumn. Morning dew also, according to Bechtle, has a favourable effect in this respect.

On the basis of these observations, the author advises two operations: removal of leaves and watering.

Leaves should not be removed all at once or too quickly. They must be taken off one by one and on several different occasions, not by tearing them off, but by cutting through the middle of the stalk, so as to spare the eyes at the base. They must be removed only in the evening or in dull weather, when transpiration is greatly reduced.

With the finest apples, in particular those of the "Api" variety, gardeners grow them in individual bags, which they gradually tear off at ripening time. They even turn the apple on its stalk, so as to expose several sides to the sun.

Watering consists in spraying with a syringe in the September evenings, when the day has been warm, and aiming preferably at the side exposed to the sun, so as to bring about enlargement and colouring. M. Opoix, chief Gardener at the Luxembourg Gardens in Paris, advises the use of water containing a handful of salt to every 10 litres of water.

LEGAL DECISIONS AFFECTING AGRICULTURE.

Finance Act, 1894—Estate Duty—Value of Unexhausted Manures.—*Commissioners of Inland Revenue v. Reid's Trustees.*—In the Outer House of the Court of Session Lord Blackburn has given judgment in an action at the

instance of the Lord Advocate on behalf of the Commissioners of Inland Revenue against Miss Elizabeth Reid, Cruivie, Wormit, Fife, and others, the Trustees of the late David Reid, farmer, Cruivie, to have an account rendered of the value of manures, so far as unexhausted, applied by the late David Reid on two farms at Cruivie and Wester Kinnear, to enable the estate duty payable on his death in respect of such value to be ascertained.

His Lordship found for the defenders and in giving judgment said that the late David Reid, who died on 28th June 1917, was at the date of his death tenant of two farms under leases which terminated at Martinmas 1919 and Martinmas 1923. It was admitted by the defenders, his trustees and executors, that during the course of his farming operations the deceased had applied artificial manures and also manures produced from feeding stuffs purchased by him to the lands, and at the date of his death certain unexhausted manurial value remained in the soil of the farms which was not included in the Inventories given up by them and on which estate duty had not been paid. They denied, however, that either the manures themselves or their unexhausted value was property passing on the death of the deceased. The only plea-in-law in support of the claim for the Crown was that the unexhausted manures were "property which passed on the death of the deceased within the meaning of the Finance Act, 1894."

In his Lordship's opinion the claim could not be sustained under any of the provisions of the Act. The moment a tenant under a lease applied manures to a farm the manures became *partes soli* inseparable from the subject of the lease, and his right to the benefit of any enhanced value in the soil arose under the lease and not from any right of property in the manures. That he had no right of property in the manures is recognised by the provision of the Agricultural Holdings Acts, which alone entitle him to compensation from the landlord for the unexhausted value of the manure at the end of his lease.

Accordingly his Lordship thought it clear that neither the unexhausted manures nor the values thereof were the property of the tenant within the meaning of Section 1 of the Act. Nor did he think they could be included as property in the sense of Section 2 (1) (a) in respect that he was at his death competent to dispose of them as subjects separate from the lease of the farms. As to Section 2 (1) (d), he did not think it had any application to the case at all. It dealt with insurances by the deceased, out of which after his death a beneficial interest accrued to some survivor. It was quite certain that the unexhausted values of the manures did not arise as a result of the death of the tenant.

His Lordship accordingly assoilized the defenders from the conclusions of the summons.

Agricultural Holdings Scotland Act, 1908—Single Arbitrator.—*Roger v. Hutcheson and Greenshields*.—Reference is made to the Report of this case in the *Journal* of April 1921, p. 223.

The pursuer reclaimed to the First Division of the Court of Session and the Division have sustained the reclaiming note, recalled the interlocutor of the Lord Ordinary, and granted decree to allow the submission to proceed.

Thus the Division have decided that arbiters or an oversman in a common law reference for the valuation of awaygoing crops, etc., as between the awaygoing and incoming tenants, may competently deal with a claim for compensation for improvements under the Agricultural Holdings Acts, where the incoming tenant has taken over the landlord's obligations to meet such a claim against him at the instance of the awaygoing tenant. This may seem strange in view of the clear provision of the Act that all claims for compensation under it shall be referred to a single arbitrator, notwithstanding any agreement to the contrary. The Division took the view that this provision was merely intended to allow parties to depart from an agreement in a lease for submission of such claims to the decision of arbiters and an oversman, and did not apply to a case like the present one, where the parties had actually entered into a Minute of Submission in which the claim, along with the ordinary awaygoing valuations, was referred to two arbiters and an oversman.

OFFICIAL ORDERS AND CIRCULARS.

THE following is the text of the Seeds (Scotland) Regulations, 1921,¹ dated 12th July 1921, made by the Board of Agriculture for Scotland under the Seeds Act, 1920:—

The Board of Agriculture for Scotland in pursuance of the provisions of the Seeds Act, 1920, and after consultation with representatives of the interests concerned (and as respects forest tree seeds, after consultation with the Forestry Commissioners), hereby make the following Regulations:—

COMMENCEMENT.

1. These Regulations shall take effect on the first day of August nineteen hundred and twenty-one, and remain in force until altered or revoked by the Board of Agriculture for Scotland.

2. The seeds to which the Seeds Act, 1920, shall apply are as follows:—

(a) *Grass and Clover Seeds of the following kinds (under whatever trade names sold):*—

Perennial Ryegrass.	Alsike Clover.
Italian Ryegrass.	White Clover.
Meadow Fescue.	Crimson Clover.
Cocksfoot.	Trefoil.
Crested Dogstail.	Lucerne.
Timothy.	Sainfoin.
Red Clover.	

(b) *Cereal Seeds of the following kinds:*—

Wheat.	Oats.
Barley.	Rye.

(c) *Field Seeds of the following kinds:*—

Tares or Vetches.	Field Kohl Rabi.
Field Turnip.	Mangel.
Swede.	Field Peas.
Rape.	Field Beans
Field Cabbage.	Sugar Beet.
Field Kale.	

(d) *Garden Seeds of the following kinds:*—

Peas.	Brussels Sprouts.
Dwarf and Broad Beans.	Broccoli.
Runner Beans.	Cauliflower.
Garden Turnip.	Carrot.
Garden Cabbage.	Parsnip.
Garden Kale.	Beet.
Garden Kohl Rabi.	Onion.
Garden Swede.	

(e) *Flax Seed and Linseed.*

(f) *Forest Tree Seeds of the following kinds:*—
Coniferous—

- Scots Pine, *Pinus silvestris*, L.
- Austrian Pine, *Pinus austriaca*, Hoess.
- Corsican Pine, *Pinus Laricio*, Poir.
- European Larch, *Larix europaea*, D.C.
- Japanese Larch, *Larix leptolepis*, Endl.
- Douglas Fir (Oregon or green Douglas), *Pseudotsuga Douglassii*, Carr.
- Douglas Fir (Colorado or blue Douglas), *Pseudotsuga Douglassii*, var. *glauca*, Hort.

¹ Copies of the Regulations are obtainable from H.M. Stationery Office, 23 Forth Street, Edinburgh, price 3d. net.

Norway Spruce, *Picea excelsa*, L.

Menzies or Sitka Spruce, *Picea Menziesii*, Carr.

Silver Fir, *Abies pectinata*, D.C.

Silver Fir (grand), *Abies grandis*, Lindl.

Hemlock Spruce, *Tsuga Mertensiana*, Carr.

Red or Canoe Cedar, *Thuja gigantea*, Nutt. (syn. *plicata*, Don. or syn. *Lobbi*, Hort.).

Broad-leaved—

Common Oak (Sessile), *Quercus sessiliflora*, Salisb.

Common Oak (Pedunculate), *Quercus pedunculata*, Ehrh.

Beech, *Fagus sylvatica*, L.

Ash, *Fraxinus excelsior*, L.

3.—(1) The particulars to be stated in the case of a sale or exposure for sale of seeds or seed potatoes as required by Section 1 of the Seeds Act, 1920, are as follows:—

- (a) in all cases the name and address of the seller ;
- (b) in all cases (except in relation to seed potatoes) that the seeds have been tested in accordance with the provisions of the Seeds Act, 1920 ;
- (c) in all cases the kind of seeds sold or exposed for sale, and in the case of Cereals, Red Clover, White Clover, Crimson Clover, and Sainfoin, the distinctive name of the variety of the seeds, or if the distinctive name of the variety is not known, or the stock is mixed, a statement to that effect.

Seed Potatoes—

- (d) Subject as hereinafter provided, in the case of seed potatoes, a statement as to whether the potatoes are Class I. (Scotch), Class I. (Irish), Class I. (English once grown), or Class II., and a statement of the variety, size and dressing ; provided that for the purposes of these Regulations "Class I. (Scotch)" means potatoes grown in Scotland ; "Class I. (Irish)" means potatoes grown in Ireland ; "Class I. (English once grown)" means potatoes grown in England or Wales which are the produce of seed grown in Scotland or Ireland in the preceding year ; and "Class II." means all other potatoes ; that "variety" shall not be held to be incorrectly stated if the statement is true in respect of 97 per cent. of the total quantity sold or exposed for sale ; that a statement of "size and dressing" shall mean a statement of the size of the mesh (exclusive of the thickness of the wire) of the riddles through and by which, respectively, the potatoes may be passed and retained ; and that in the case of a sale of potatoes as grown and with the written description "as grown," no reference need be made to the size of the mesh of the top riddle.

Grass and Clover Seeds—

- (e) In the case of grass and clover seeds named in Regulation 2 (a) (1) the country of origin (England, Wales, Scotland, and Ireland, being for this purpose treated as different countries), or, if the country of origin is not known, a statement to that effect ; (2) the percentage of purity ; (3) the total percentage by weight of injurious weed seeds prescribed in Regulation 4, where such total exceeds 1 per cent. in the case of clovers, and 2 per cent. in the case of grasses ; (4) the percentage of germination ; (5) the percentage of pure germinating seed, calculated by multiplying the percentage of purity by the percentage of germination, and dividing the product by 100 ; and (6) in the case of Ryegrasses, the Imperial Bushel Weight ; provided that in the case of Perennial Ryegrass and Italian Ryegrass, or a mixture of Perennial and Italian Ryegrasses, if the percentage of purity is not less than 98 and the percentage of germination is not less than the authorised minimum percentage of germination prescribed in the First Schedule to these Regulations, a statement to that effect, which shall include the authorised minimum percentage of germination,

- may be substituted for the particulars required under (2), (4), and (5) of this clause ;
- (f) a statement that Dodder is present, if it is present to the extent of more than one seed thereof in 1 oz. of Wild White Clover or in 2 ozs. of Alsike Clover, White Clover, or Timothy, or in 4 ozs. of Red Clover, Crimson Clover, or Lucerne ;
 - (g) in the case of White Clover, Wild White Clover, and Alsike Clover, where more than 2 per cent. by weight of any or all of the following taken collectively—namely, Suckling Clover (*Trifolium dubium*, Sibth.), Hop Clover (*T. procumbens*, L.), *T. parviflorum*, Ehrh., *T. angulatum*, Waldst., and *T. glomeratum*, L., is present in the sample, the percentage so present ;
 - (h) in the case of Sainfoin, where more than 5 per cent. by weight of Burnet (*Poterium spp.*) is present in the sample, the percentage so present ;
 - (i) in the case of Clovers, Trefoil, Lucerne, and Sainfoin, the percentage by number of hard seeds as distinct from the percentage number of the seeds that germinate during a germination test ;
 - (j) in the case of mixtures of Grasses or of Clovers or of Grasses and Clovers, including such seed as may be described as "hay seed," "grass seed," "white hay," or "brown hay," sold or exposed for sale for agricultural purposes, the particulars mentioned in paragraphs (c), (e), (f), (g), (h), (i) shall be given in respect of each of the kinds of grass or clover seed named in Regulation 2 (a) which is included in the mixture, and the proportion by weight of each kind shall also be given, provided that in the case of a mixture containing in addition varieties of grass or clover seed not specified in these Regulations the total percentage by weight of injurious weed seeds prescribed in Clause 4 of these Regulations shall be stated where such total exceeds 2 per cent of the mixture as a whole ; provided, also, that in a mixture of Perennial Ryegrass and Italian Ryegrass the proportion by weight of each kind need not be stated if such mixture be declared to be a mixture of Perennial Ryegrass and Italian Ryegrass.
 - (k) in the case of a blend of varieties of the same species having different countries of origin, the country of origin of each of the components shall be stated, but the other particulars required by these Regulations shall be stated in respect of the blend as a whole and not in respect of each component part.

Cereal Seeds—

- (l) In the case of the cereal seeds named in Regulation 2 (b), the percentage of germination, provided that, if the percentage of germination is not less than the authorised minimum percentage of germination prescribed in the Second Schedule to these Regulations, a statement to that effect, which shall include the authorised minimum percentage of germination, shall be sufficient.

Field Seeds—

- (m) In the case of the field seeds named in Regulation 2 (c), (1) the percentage of purity if below 97, and (2) the percentage of germination, provided that if the percentage of germination is not less than the authorised minimum percentage of germination prescribed in the Third Schedule to these Regulations, a statement to that effect, which shall include the authorised minimum percentage of germination, shall be sufficient.

Garden Seeds—

- (n) In the case of the garden seeds named in Regulation 2 (d) (subject as hereinafter provided by Clause (2) of this Regulation), (1) the percentage of purity if below 97 ; provided that in the case of carrot seed the percentage of purity need not be stated unless it is below 90 ; and (2) the percentage of germination ; provided that if the percentage of germination is not less than the authorised minimum percentage of germination prescribed in the Fourth Schedule to these Regulations, a statement to that effect, which

shall include the authorised minimum percentage of germination, shall be sufficient.

Flax Seed and Linseed—

- (o) In the case of Flax Seed and Linseed, (1) the country of origin (England, Wales, Scotland, and Ireland being for this purpose treated as different countries), or if the country of origin is not known, a statement to that effect ; (2) the percentage of purity ; (3) a statement that Dodder is present if it is present to the extent of more than one seed thereof in 4 ozs. ; and (4) the percentage of germination.

Forest Tree Seeds—

- (p) In the case of the Forest Tree Seeds named in Regulation 2 (f), (1) the percentage of purity ; (2) except in the case of broad-leaved kinds, the percentage of germination ; (3) the year and month of collection of the seeds, and (4) the country of origin (England, Wales, Scotland, and Ireland being for this purpose treated as different countries), or if the country of origin is not known, a statement to that effect.

(2) The particulars required by this Regulation shall not apply in the case of a packet containing pea or bean seed (not exceeding 2 lbs.), or of any other garden seed named in Regulation 2 (d) (not exceeding 8 ozs.), if the following particulars are stated on the packet—that is to say, (1) the name and address of the seller ; (2) a statement that the seeds have been tested in accordance with the provisions of the Seeds Act, 1920 ; (3) the kind of seed ; (4) the season in which the seed was packeted, provided that the term "season" shall for the purpose of this provision mean a twelve months' season ending the 31st July, and that it shall be sufficient to state the year in which the season expires ; (5) the percentage of purity if such percentage is, in the case of Carrot Seed, below 90, or in the case of any other seeds, below 97, and (6) the percentage of germination, provided that, if the percentage of germination is not less than the authorised minimum percentage of germination prescribed in the Fourth Schedule to these Regulations, a statement to that effect shall be sufficient.

4.—(1) The injurious weed seeds to which Section 3 of the Seeds Act, 1920, and any Regulation referring to injurious weed seeds, shall apply, are :

Docks and Sorrels (*Rumex spp.*).
Cranesbills (*Geranium spp.*).
Wild Carrot (*Daucus Carota*, L.).
Yorkshire Fog (*Holcus lanatus*, L.).
Soft Brome Grass (*Bromus mollis*, L. *et spp.*).

(2) For the purposes of Section 3 of the Seeds Act, 1920, the prescribed maximum quantity of injurious weed seeds shall be 5 per cent. by weight.

SAMPLES.

5.—(1) A sample taken for the purpose of a test to be made in accordance with the provisions of the Seeds Act, 1920, must be taken in the following manner (provided that the proportion of sacks or bags from which portions are drawn may be greater) :—

- (a) where the quantity of seeds sampled is four bushels or under, portions shall be drawn from the top, middle and bottom of the bag or bags in which the seeds are contained. All the portions so taken shall be well mixed, and a representative sample of the whole shall be used ;
- (b) where the quantity of seeds sampled exceeds one sack (four bushels), portions shall be drawn from each sack ; these portions shall be thoroughly mixed, and a representative sample of the whole shall be taken ; provided that if the quantity sampled exceeds 5 sacks, and does not exceed 50 sacks, portions need only be taken from one sack in five with a minimum of five sacks ; and if the quantity sampled exceeds 50 sacks, portions need only be taken from one sack in ten with a minimum of ten sacks ; provided also

- that in the case of Cereals, Tares or Vetches, Field Beans and Field Peas, if the quantity sampled exceeds 100 sacks, portions need only be taken from one sack in twenty with a minimum of ten sacks ;
- (c) in the case of seeds stored in heaps or bins, the sample shall be one made up of representative portions taken from various parts of the heap or bin so as fairly to represent the bulk ;
- (d) a sample shall be deemed to have been correctly taken if drawn from various parts of the seed whilst passing from a cleaning machine ;
- (e) in the case of seed potatoes a sample shall consist of not less than five of the larger and five of the smaller sized potatoes for every hundredweight or part of a hundredweight of which the quantity sampled consists, provided that where the quantity sampled amounts to one ton or over, fifty of the larger and fifty of the smaller sized potatoes shall be sufficient.

(2) The sample must be sufficiently large to enable each part which, in accordance with the provisions of the Act, is submitted for testing, or delivered or tendered to the owner of the seeds, or sent to the seller thereof, to be of at least the following weights or quantities :—

Garden Swede	Not less than ½ oz.
„ Turnip	
„ Cabbage	
„ Kale	
„ Kohl Rabi	
Brussels Sprouts	
Broccoli	
Cauliflower	
Carrot	
Parsnip	
Onion	
Wild White Clover	Not less than 1 oz.
Ryegrasses	
Meadow Fescue	
Cocksfoot	
Crested Dogtail	
Timothy	
Alsike Clover	
White Clover (other than Wild)	
Field Turnip	Not less than 2 ozs.
Swede	
Rape	
Field Cabbage	
„ Kale	
„ Kohl Rabi	
Mangel	
Beet and Sugar Beet	
Wheat	
Oats	
Barley	
Rye	
Tares or Vetches	
Red Clover	
Crimson Clover	
Trefoil	Not less than 4 ozs.
Lucerne	
Sainfoin	
Flax and Linseed	
Peas (Field and Garden)	
Beans (Tick and Winter)	
Dwarf Beans	
Broad Beans	Not less than 8 ozs.
Runner Beans	
Menzies or Sitka Spruce	Not less than 1 oz.

Hemlock Spruce	..	..	..	..	} Not less than $\frac{1}{2}$ oz.
Red or Canoe Cedar	..	..	..	..
All other kinds of Forest Tree seeds	..	..	..	..	Not less than 2 ozs.
Sealed packets of seeds	..	..	..	..	Three unbroken packets

(3) A sample of seeds taken under Section 4 of the said Act need not be divided into equal parts, provided that the part delivered or tendered to the owner of the seeds complies with the preceding provision.

(4) Where a sample of seeds has been taken under Section 4 of the Seeds Act, 1920, in the presence of and marked by the owner of the seeds or his representative, or has been taken under Section 6 of the said Act in the presence of and marked by the seller or his representative, the sample shall be deemed to have been duly taken.

LICENSING.

6. A licence under sub-section (7) of Section 1 of the Seeds Act, 1920, exempting any person or persons as respects any sale or exposure for sale of seeds or seed potatoes, may be granted in any case where the Board are satisfied that the circumstances connected with the sale or exposure for sale or intended sale or exposure for sale, are such that compliance with the provisions of Section 1 of the said Act, either generally or in a particular respect, cannot reasonably be enforced, and that an exemption should be granted so as to apply generally to all persons or to a particular person, and either as regards all the provisions of Section 1 or any of those provisions and, in any case, subject to such conditions (if any) as may be specified in the licence.

DEFINITIONS.

7.—(1) "Purity" as referred to in these Regulations means analytical purity, and the term "Pure seed" means the seed of which the parcel purports to consist after the impurities, as defined below, have been eliminated, but in the case of those species, varieties, stocks, or strains of plants, the seeds of which cannot be distinguished from one another by expert examination, the use of the term purity does not imply that the seed is genuine or true to name.

(2) "Impurities" means all seeds or portions of seeds other than those of which the parcel purports to consist, whether they are those of weed-, harmless plants, or other cultivated plants, and also broken seeds of the kind of which the parcel purports to consist so far as they are incapable of germinating, and also foreign matter, sand, grit, soil, fragments of roots, stems or flowers, sprouted seeds, single glumes, single pales, pales without a kernel, smut, ergot, and other sclerotia, broken cones, scales, and seed wings, and in the case of mangel and beet seed, clusters wholly devoid of seeds and all material which passes through a sieve having circular holes of 2.5 millimetres diameter.

(3) "Percentage of Purity" means the percentage by weight of pure seed as defined above.

(4) "Percentage of germination" means the percentage by number of pure seed as defined above which germinate during a germination test

(5) When a sample of seed purporting to be one of a kind mentioned in Regulation (2) (a) contains an amount exceeding 15 per cent. by weight of one or more other kinds of seeds not being seeds of species commonly regarded as weeds, the sample shall be deemed to be a mixture.

LIMITS OF VARIATION.

8. For the purpose of any legal proceedings on a contract for the sale of seeds, being a sale to which the Seeds Act, 1920, applies, the Limits of Variation in respect of the percentage of germination and the percentage of purity shall be as set out in the Fifth Schedule to these Regulations.

CERTIFICATES.

9.—(1) The certificate required under Section 4 (3) of the Seeds Act, 1920, shall be in the form set out in the Sixth Schedule hereto.

(2) A copy of a certificate shall be sent to the Board and a copy thereof shall be sent by the Board to the owner of the seeds, and where a seller not being the owner of the seeds has required that further portions of the sample shall be tested, to such seller.

SHORT TITLE.

10. These Regulations may be cited as the Seeds (Scotland) Regulations, 1921.

In witness whereof the Board of Agriculture for Scotland have hereunto set their official seal this twelfth day of July nineteen hundred and twenty-one.

(L.S.)

CHAS. WEATHERILL,
Secretary.

First Schedule.

The authorised minimum percentages of germination for the purpose of Regulation 3 (1) (e) shall be:

	<i>Germination per cent.</i>
Italian Ryegrass	80
Perennial Ryegrass	85
Mixtures of Italian and Perennial Ryegrass ..	82

Second Schedule.

The authorised minimum percentages of germination for the purpose of Regulation 3 (1) (l) shall be:

	<i>Germination per cent.</i>
Wheat	90
Barley	90
Oats	85
Rye	80

Third Schedule.

The authorised minimum percentages of germination for the purpose of Regulation 3 (1) (m) shall be:

	<i>Germination per cent.</i>
Tares and Vetches	90
Field Turnips	80
Swede	80
Rape	80
Field Cabbage	70
Field Kale	70
Field Kohl Rabi	70
Mangel	60
	(of clusters)
Field Beans (Tick and Winter)	90
Field Peas (Maple and Dun)	80
Sugar Beet	60
	(of clusters)

Fourth Schedule.

The authorised minimum percentages of germination for the purpose of Regulation 3 (1) (n) shall be:

	<i>Germination per cent.</i>
Peas	70
Dwarf and Broad Beans	75
Runner Beans	60
Garden Turnip	75
„ Cabbage	70
„ Kale	70
„ Kohl Rabi	70
„ Swede	75
Brussels Sprouts	70
Broccoli	65
Cauliflower	65
Carrot	50
Parsnip	45
Beet	50
	(of clusters)
Onion	60

Fifth Schedule.

LIMITS OF VARIATION.

Germination.

Where the percentages of germination stated in the prescribed particulars are :

	<i>Allow per cent.</i>					
At or between 100-95	±4
At or over 90 but less than 95	±6
" " 85 " " 90	±7
" " 75 " " 85	±8
" " 55 " " 75	±9
" " 45 " " 55	±10
" " 25 " " 45	±9
" " 15 " " 25	±8
" " 10 " " 15	±7
" " 5 " " 10	±6
Less than 5	±4

Except in the case of forest tree seeds in respect of which a general limit of variation for germination of ± 10 per cent. is allowed.

Purity.

Where the percentages of total pure seed stated in the prescribed particulars are :

	<i>Allow per cent.</i>					
At or between 100-98	±1
At or over 90 but less than 98	±2
" " 80 " " 90	±4
Less than 80	±5

Except in the case of forest tree seeds in respect of which a general limit of variation for purity of ± 5 per cent. is allowed.

Where the percentage of germination or purity is stated by the seller with a range—e.g. 94-90 per cent.—the percentage for the purposes of the limits of variation shall be the mean—i.e., in the above case, 92 per cent.

Injurious Weed Seeds.

	<i>Allow per cent.</i>					
Where the percentage of injurious weeds does not exceed 2 per cent.	±1
Exceeds 2 per cent. but does not exceed 5 per cent.	±2
Exceeds 5 per cent.	±3

Sixth Schedule.

The certificate required under Section 4 (3) of the Seeds Act, 1920, shall be in the following form :—

OFFICIAL SEED TESTING STATION FOR SCOTLAND. SEEDS ACT, 1920.
FINAL REPORT.

Control Sample No
 Station No.
 Description
 Taken on premises of
 Date of Sampling
 Date received at Station

Germination per cent. Purity per cent.
 Hard Seeds per cent.



POTASH



YOUR SOILS NEED POTASH

to maintain fertility.

YOUR CROPS NEED POTASH

- (1) to produce strong hardy plants, better able to stand the weather, and to resist diseases;
- (2) to give the largest yields of produce, which sells best, which feeds best, and which keeps best.

OF PRE-WAR STANDARD QUALITY.

Kainit	-	-	-	12½-15 per cent.
Potash Manure Salt	-	20	„	
Potash Manure Salt	-	30	„	
Muriate of Potash	-	70-95	„	Purity
Sulphate of Potash	-	90-96	„	„
Sulphate of Potash-Magnesia	48	„	„	Sulphate

Full supplies of the above available from the Potash Syndicate.

LOW PRICES.

SOLD BY ALL MANURE MERCHANTS.

Please write for Address of Merchants nearest who can supply you to

Messrs HUGO KNOBLAUGH, SONS & CO., LTD.,
28 BALTIC STREET, LEITH.

Write for Information and Literature on how to use Potash and
 General Manuring Questions

To J. GORDON, B.Sc. (AGR.),
10, St. Leonard's Bank, PERTH.

YOUR SOIL NEEDS NITROGEN

And there are several ways of supplying it.

THE BEST IS NITRATE OF SODA

For it is easy to apply, acts almost immediately, and ensures Bigger
∴ Crops and Larger Profits. ∴

*Write for Special Pamphlets, supplied gratis
and Post Free by*

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131 WEST REGENT STREET,
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JOHNSON & DARLINGS

LIMITED,

**Grain and Seed Merchants,
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HIGH-CLASS FARM SEEDS.

MANURES to suit all CROPS.

*High Guarantees and
Fine Condition.*

ADDRESS:

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*The New "INVISIBLE"
Frameless Spectacles and
Eyeglasses a Speciality*

Also 52 Queen St., GLASGOW

(Note the Numbers).

Injurious Weed Seeds.....per cent.

Dodder.....

Percentage of pure Germinating Seed.....

Other particulars

.....

.....

Date.....

.....
Director,

Official Seed Testing Station.

**Egg Distributing
Schemes, 1922.**

THE Board have issued their schemes for the distribution of sittings of eggs of pure breeds of utility poultry during season 1922. These schemes have been drawn up on similar lines to those of last year—*i.e.*

Holders of hen and duck egg distributing stations must distribute eggs from approved birds at a price not exceeding 5s. per dozen, and the bonus payable by the Board in respect of eggs so distributed will be 2s. per dozen. One person in any household is entitled to obtain, during the distributing period (from 15th January to 31st May), and if the supply permits, a maximum quantity of four sittings of hen eggs and four sittings of duck eggs.

Holders of turkey and goose stations must distribute eggs at a price not exceeding 1s. 6d. each, the bonus payable by the Board being 9d. for each egg distributed. The maximum quantity distributed to any person in one household must not exceed twelve turkey and twelve goose eggs.

Lists of holders of egg distributing stations will be published early in 1922.

**Pony Stallion
Licences.**

Horse-Breeding Act, 1918.—Hitherto the fee charged for a licence under this Act has been half-a-guinea for a pedigree stallion not exceeding 15 hands in height, but it has recently been decided

to make the fee a uniform one of a guinea.

STATISTICS.

PRICES of AGRICULTURAL PRODUCE and FEEDING STUFFS
in June, July and August 1921.

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND.*

(Compiled from Reports received from the Board's Market Reporters.)

Description.	JUNE.			JULY.			AUGUST.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
FAT STOCK:—									
CATTLE—	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.	per cwt. l.w. s. d.
Aberdeen-Angus ...	95 9	86 10	69 2	92 6	84 0	65 6	90 7	82 7	55 10
Shorthorn ...	93 0	87 2	68 10	89 9	84 0	68 0	85 5	79 7	56 10
Galloway ...	90 3	86 3	78 6	81 6	76 3	68 6	81 6	77 2	71 0
Ayrshire ...	87 2	73 0	52 5	78 9	66 9	47 6	76 0	60 5	40 10
Cross-bred ...	91 5	83 4	68 7	87 8	79 7	64 2	86 3	78 5	57 4
Blue Grey ...	87 0	80 0	...	76 0	73 6	...	83 5	79 2	71 0
Highland ...	...	...	...	...	...	...	78 0	76 0	...
VEAL CALVES ...	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.	per lb. d.
	19½	12½	9	18½	11½	8½	19½	11	8½
SHEEP—	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.	under 60 lb. per lb. d.	60 lb. and upw'ds. per lb. d.	Ewes per lb. d.
Cheviot ...	23½	21½	18½	21	19½	17	19½	18½	15
Half-bred ...	22½	21	17	20½	19	15½	19	18	13½
Blackface ...	21½	19½	17½	20½	18½	16	18½	17½	14½
Greyface ...	22½	21½	17½	21	19½	15½	19½	18½	14
Down Crosses ...	23	21½	...	21	19½	...	19½	18½	...
PIGS—	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.	per stone. s. d.
Bacon Pigs ...	20 5	18 2	15 2	18 0	15 11	11 6	17 5	15 4	10 11
Porkers ...	20 9	19 0	15 4	18 4	16 10	12 2	17 9	16 0	11 6

AVERAGE PRICES OF LIVE STOCK IN SCOTLAND—*continued.*

Description.	JUNE.			JULY.			AUGUST.		
	1st.	2nd.	3rd.	1st.	2nd.	3rd.	1st.	2nd.	3rd.
STORE STOCK:—									
STORE CATTLE—									
Aberdeen-Angus :	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.	per head.
Yearlings ...	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Two-year-olds ..	30 14	24 8	20 1	28 1	22 3	18 7	21 0	18 7	13 0
Yearlings ...	41 18	33 19	27 0	37 13	28 10	...	34 8	25 12	...
Two-year-olds ..	...	...	...	...	...	...	...	...	...
Shorthorn :	...	...	...	...	...	...	...	...	...
Yearlings ...	...	...	...	...	...	...	...	...	...
Two-year-olds ..	...	...	...	...	...	...	...	...	...
Galloway :	...	...	...	...	...	...	...	...	...
Yearlings ...	25 10	21 7	17 0	20 0	17 0	12 0	17 5	16 8	12 16
Two-year-olds ..	43 0	34 18	30 0	29 0	27 8	20 0	27 10	22 13	18 0
Ayrshire :	...	...	...	...	...	...	...	...	...
Yearlings ...	19 3	16 0	13 7	18 0	...	...	...	...	...
Two-year-olds ..	27 10	22 0	18 0	24 0	21 15	...	...	...	...
Cross-bred :	...	...	...	...	...	...	...	...	...
Yearlings ...	29 6	23 12	18 16	23 15	20 2	14 10	20 8	16 14	12 0
Two-year-olds ..	39 17	33 11	27 2	34 10	27 17	24 1	31 19	25 5	20 7
Blue Grey :	...	...	...	...	...	...	...	...	...
Yearlings ...	28 0	23 0	18 0	...	...	...	...	...	...
Two-year-olds ..	45 0	37 0	30 0	...	25 15	...	...	...	...
Highland :	...	...	...	...	...	...	...	...	...
Yearlings ...	19 5	15 12	11 12	15 3	13 0	9 13	...	...	...
Two-year-olds ..	29 0	24 8	20 3	24 5	20 13	18 8	...	...	...
Three-year-olds ..	40 18	36 5	31 2	36 0	...	...	...	...	...
DAIRY COWS—									
Ayrshire :	...	...	...	...	...	...	...	...	...
In Milk ...	55 12	37 2	19 19	51 16	37 7	18 0	56 10	34 10	17 0
Calvers ...	51 16	36 12	23 13	52 2	36 11	22 18	48 12	34 16	22 4
Shorthorn Crosses :	...	...	...	...	...	...	...	...	...
In Milk ...	63 1	51 12	36 1	63 1	49 7	36 9	60 15	45 9	33 11
Calvers ...	54 9	41 2	28 6	56 17	39 10	25 3	54 12	40 5	25 16
STORE SHEEP—									
Cheviot Hoggs ...	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Half-bred Hoggs ...	90 3	80 4	59 9	60 0	55 0	...	70 0	62 6	46 10
Blackface Hoggs ...	102 6	83 8	72 3	...	...	...	70 0	51 6	55 0
Greyface Hoggs ...	54 6	48 3	39 2	50 0	...	34 3	...	38 9	...
...	92 7	76 3	64 0	82 1	63 4	...	79 4	67 6	...
STORE PIGS—									
(6 to 10 weeks old)	90 1	66 9	...	74 9	52 4	...	58 8	36 10	...

AVERAGE PRICES OF DEAD MEAT AT DUNDEE, EDINBURGH,
AND GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	Quality.	June.			July.			August.		
		Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.	Dundee.	Edinburgh.	Glasgow.
BEEF :—										
Home-fed—		per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.	per lb.
Bullock or Heifer ...	1	14 ³ / ₄	16	16 ¹ / ₂	14 ³ / ₄	15 ³ / ₄	15 ³ / ₄	13 ³ / ₄	14 ³ / ₄	15 ³ / ₄
	2	13 ³ / ₄	14	15 ³ / ₄	13 ³ / ₄	13 ³ / ₄	14 ³ / ₄	13 ³ / ₄	13 ³ / ₄	14 ³ / ₄
Bull	1	12 ³ / ₄	14 ³ / ₄	13 ³ / ₄	12 ³ / ₄	14 ³ / ₄	12 ³ / ₄	12 ³ / ₄	15 ³ / ₄	11 ³ / ₄
	2	11 ³ / ₄	13 ³ / ₄	12 ³ / ₄	11 ³ / ₄	13 ³ / ₄	11 ³ / ₄	11 ³ / ₄	12 ³ / ₄	11
Cow	1	11 ³ / ₄	12 ³ / ₄	12 ³ / ₄	11 ³ / ₄	10 ³ / ₄	11 ³ / ₄	10 ³ / ₄	9 ³ / ₄	10 ³ / ₄
	2	9 ³ / ₄	10 ³ / ₄	11	10	9 ³ / ₄	10 ³ / ₄	8 ³ / ₄	8 ³ / ₄	9 ³ / ₄
Irish—										
Bullock or Heifer ...	1	...	...	15	...	...	14	...	...	13 ³ / ₄
	2	...	...	14 ³ / ₄	...	...	13 ³ / ₄	...	...	13
Bull	1	...	...	12 ³ / ₄	...	...	11 ³ / ₄	...	...	11
	2	...	...	11 ³ / ₄	...	...	11 ³ / ₄	...	...	10 ³ / ₄
United States—										
Killed at Glasgow ...	1	13 ³ / ₄	...	14 ³ / ₄	...	...	13 ³ / ₄	...	...	...
	2	13	...	14	...	...	12 ³ / ₄	...	...	...
Killed at Birkenhead...	1	...	...	15	...	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...
Canadian —										
Killed at Glasgow ...	1	...	...	...	...	...	...	...	...	13 ³ / ₄
	2	...	...	...	...	...	...	...	...	12 ³ / ₄
Argentine Frozen—										
Hind Quarters ...	1	10	10 ³ / ₄	...	9 ³ / ₄	10	9 ¹ / ₂	9 ¹ / ₂	9 ⁵ / ₈	9
Fore „ ...	1	5 ³ / ₄	5 ³ / ₄	...	5 ³ / ₄	5	5	5 ¹ / ₂	5 ³ / ₄	4 ³ / ₄
Argentine Chilled—										
Hind Quarters ...	1	10 ³ / ₄	10 ³ / ₄	10 ³ / ₄	...	10 ³ / ₄	10 ³ / ₄	...	10 ³ / ₄	...
	2	...	...	10 ³ / ₄	...	...	...	...	...	...
Fore „ ...	1	5 ³ / ₄	5	5 ³ / ₄	...	5 ³ / ₄	5 ³ / ₄	...	5 ³ / ₄	...
	2	...	...	5 ³ / ₄	...	...	...	...	...	...
Australian Frozen—										
Hind Quarters ...	1	...	...	...	...	...	7 ¹ / ₂	...	...	5 ³ / ₄
	2	...	...	...	...	...	7	...	...	...
MUTTON :—										
Hoggs, Blackface ...	under 60 lb.	22 ³ / ₄	21 ³ / ₄	21 ³ / ₄	21 ³ / ₄	19 ³ / ₄	18 ³ / ₄	19 ³ / ₄	16 ³ / ₄	16 ³ / ₄
	60 lb. and over.	21 ³ / ₄	20 ³ / ₄	21 ³ / ₄	21	18 ³ / ₄	18 ³ / ₄	18 ³ / ₄	16	16 ³ / ₄
„ Cross ...	under 60 lb.	23	22	21 ³ / ₄	21 ³ / ₄	20 ³ / ₄	18 ³ / ₄	20 ³ / ₄	17 ³ / ₄	16 ³ / ₄
	60 lb. and over.	22	20 ³ / ₄	21 ³ / ₄	21	19 ³ / ₄	18 ³ / ₄	19 ³ / ₄	16 ³ / ₄	16 ³ / ₄
Ewes, Cheviot ...	1	20	16 ³ / ₄	19	19 ³ / ₄	17	16 ³ / ₄	16 ³ / ₄	12 ³ / ₄	13 ³ / ₄
	2	19	10	...	18	...	15 ³ / ₄	15 ³ / ₄	...	13
„ Blackface ...	1	20	...	19	19 ³ / ₄	...	16 ³ / ₄	16 ³ / ₄	...	13 ³ / ₄
	2	19	...	19	18 ³ / ₄	...	15 ³ / ₄	15 ³ / ₄	...	12 ³ / ₄
„ Cross ...	1	19 ³ / ₄	16 ³ / ₄	18 ³ / ₄	17	...	16 ³ / ₄	13 ³ / ₄	11 ³ / ₄	13 ³ / ₄
	2	18 ³ / ₄	...	...	15 ³ / ₄	...	15 ³ / ₄	12 ³ / ₄	10	12 ³ / ₄
Argentine Frozen	1	9	8 ³ / ₄	9	9	8 ³ / ₄	...	8 ³ / ₄	8 ³ / ₄	6 ³ / ₄
	2	7	...	7	...	...	...	...	...	6
Australian „	1	...	...	8 ¹ / ₂	7	...	...	...	...	...
New Zealand „	1	8 ¹ / ₂	9	8 ³ / ₄	...	...	8 ³ / ₄	...	...	8 ³ / ₄
	2	7	...	6 ³ / ₄	...	...	6 ³ / ₄	...	...	6 ³ / ₄
LAMB :—										
Home-fed	1	24 ⁵ / ₈	...	23	23 ¹ / ₂	21	20 ³ / ₄	21 ⁵ / ₈	18	19
	2	23	...	22	22 ³ / ₄	19	18 ³ / ₄	20 ³ / ₄	...	17 ³ / ₄
New Zealand Frozen...	1	14 ³ / ₄	13 ³ / ₄	13	14	13 ³ / ₄	13 ³ / ₄	14 ³ / ₄	14 ³ / ₄	13 ³ / ₄
	2	14	...	...	...	...	...	14	...	...
Argentine „ ...	1	...	13	...	...	13 ³ / ₄	...	14	...	...

AVERAGE PRICES OF PROVISIONS AT GLASGOW.

(Compiled from Reports received from the Board's Market Reporters.)

Description.		June.		July.		August.		Quantity.	Description.		June.		July.		August.	
		s.	d.	s.	d.	s.	d.				s.	d.	s.	d.	s.	d.
BUTTER:																
Irish Creamery ...	per cwt.	188	0	224	3	246	0	1	BACON (continued):							
" (Unsalted) "	"	191	7	229	0	249	10	1	American, Long Clear		...		136	0	137	0
Canadian ...	"	...	...	...	...	250	0	1	Middles (Green) ...							
" (Unsalted) "	"	...	...	...	...	...	...	1	American, Short Clear		124	0	123	0	118	5
Danish ...	"	200	5	239	9	264	5	1	Backs ...		110	0	131	6	134	5
" (Unsalted) "	"	200	0	206	0	268	8	1	American Sides ...		74	0	70	0	...	...
Australian ...	"	181	7	214	0	247	2	1	" Cumberland Cut		113	0	128	0	131	7
" (Unsalted) "	"	183	6	214	0	247	2	1	Canadian, Sides ...		82	0	111	4	126	10
New Zealand ...	"	197	2	232	3	264	0	1	Danish, Sides ...		130	0	169	6	162	0
" (Unsalted) "	"	197	2	232	3	264	0	1	HAMS:		116	7	167	3	158	7
Argentine ...	"	168	0	199	6	229	2	1	Irish (Smoked)		177	5	199	0	194	0
" (Unsalted) "	"	169	2	200	6	229	2	1	American, Long Cut		298	0	307	6	306	0
CHEESE.									(Green) ...		142	5	191	6	199	0
Cheddar ...	"	104	0	129	0	138	0	1	American, Short Cut		...	...	...	...	196	2
" ...	"	100	2	123	0	129	7	2	...		148	0	191	6	197	7
Cheddar Loaf ...	"	126	8	143	4	150	0	1	...		...	...	...	...	195	5
Dunlop ...	"	100	10	127	6	137	7	2	...		...	...	...	...	...	...
" ...	"	96	5	119	0	126	5	1	...		...	...	...	...	...	...
Canadian ...	"	103	0	121	6	130	0	1	...		2	4	2	9	3	3
" ...	"	97	3	117	0	124	0	2	Country ...		2	2	2	7	3	1
New Zealand (Coloured) "	"	119	3	122	0	130	0	1	Irish ...		22	5	23	8	28	10
" " White "	"	118	10	127	0	133	2	1	" (Duck)		20	10	22	8	27	2
BACON:									"		20	11	20	0	21	3
Ayrshire (Rolled) ...	"	238	5	238	9	241	7	1	American ...		18	6	19	6	25	0
Irish (Green) ...	"	187	5	209	6	202	0	1	Canadian ...		...	...	21	0	26	2
" (Dried or Smoked) "	"	206	7	228	0	225	7	1	Danish (Fresh)		24	6	25	11	30	1
" (Long Clear) ...	"	225	0	230	0	224	0	1	"		23	2	24	0	28	5
Wiltshire (Green) ...	"	190	5	210	0	202	0	1	Egyptian ...		13	0	...	...	...	...
" (Dried or Smoked) "	"	205	7	229	0	225	7	1	Lithuanian ...		1	10	6	...	...	...
									Polish ...		15	8	18	6	22	0

AVERAGE PRICES OF POTATOES AT DUNDEE, EDINBURGH,
AND GLASGOW.*(Compiled from Reports received from the Board's Market Reporters.)*

MARKETS.	Quality.	JUNE.					
		First Earlies.	LATE VARIETIES.				
			Red Soils.		Other Soils.		
			Lang- worthy.	Other.	Lang- worthy.	Other.	
		per ton. £ s. d.	per ton £ s. d.	per ton £ s. d.	per ton £ s. d.	per ton. £ s. d.	
Dundee	First ...	18 0 0	...	...	...	3 15 0	
	Second ...	..	...	...	...	3 5 0	
Edinburgh...	First ...	17 0 0	..	...	...	5 0 0	
	Second ...	...	...	..	..	...
Glasgow	First ...	16 0 0	...	...	...	4 10 0	
	Second ..	...	...	...	...	...
JULY.							
Dundee	First ...	12 0 0	...	...	...	...
	Second ...	...	...	...	...	...
Edinburgh...	First ...	12 5 0	...	...	..	...
	Second ...	...	...	...	...	...
Glasgow	First ...	13 0 0	...	...	...	..
	Second ...	...	...	...	...	...
AUGUST.							
Dundee	First ...	10 4 0	...	...	...	...
	Second ...	...	...	...	...	...
Edinburgh...	First ...	11 12 6	...	...	...	...
	Second ...	...	...	...	...	...
Glasgow	First ..	11 4 4	...	...	...	...
	Second ...	...	...	...	...	...

**AVERAGE PRICES OF ROOTS, HAY, STRAW, AND MOSS LITTER,
AT DUNDEE, EDINBURGH, AND GLASGOW.**

(Compiled from Reports received from the Board's Market Reporters.)

Markets.	Quality.	JUNE.									
		Roots.			Hay.		Straw.			Moss Litter.	
		Carrots.	Yellow Turnips.	Swedes.	Rye Grass and Clover.	Timothy.	Wheat.	Barley.	Oat.		
		per ton. s. d.	per ton. s. d.	per ton. s. d.	per ton s. d.	per ton s. d.	per ton. s. d.	per ton. s. d.	per ton s. d.		per ton. s. d.
Dundee *...	1	...	...	35 0	130 0	...	70 0	70 0	70 0	60 0
	2	...	...	...	110 0	...	60 0	60 0	60 0	...
Edinburgh †	1	...	...	...	100 0	...	50 6	...	48 0	...
	2	...	...	...	61 3	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	42 6
	2	...	...	...	...	...	...	...	...	...
JULY.											
Dundee *..	1	...	...	...	130 0	...	70 0	70 0	70 0	60 0
	2	...	...	...	110 0	...	60 0	60 0	60 0	...
Edinburgh †	1	...	...	...	108 9	...	48 2	40 0	47 6	...
	2	...	...	...	70 0	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	42 6
	2	...	...	...	...	...	...	...	...	...
AUGUST.											
Dundee *...	1	...	...	...	130 0	...	78 0	75 0	80 0	...
	2	...	...	...	...	...	...	...	...	...
Edinburgh †	1	...	...	...	122 6	...	50 6	40 0	51 6	...
	2	...	...	...	...	...	...	...	...	...
Glasgow ...	1	...	...	...	...	...	...	...	...	42 6
	2	...	...	...	...	...	...	...	...	...

* Price for Hay and Straw baled and delivered.

† Price for Hay and Straw delivered loose in town.

AVERAGE PRICES OF FEEDING STUFFS AT GLASGOW AND LEITH.

(Compiled from Reports received from the Board's Market Reporters.)

Description.	JUNE.		JULY.		AUGUST.	
	Glasgow.	Leith.	Glasgow.	Leith.	Glasgow.	Leith.
	per ton.	per ton.	per ton.	per ton.	per ton.	per ton.
Linseed Cake—	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Home ...	14 12 0	14 9 6	17 6 8	16 5 8	...	17 12 0
Foreign ...	13 13 4	...	...	...	...	...
Decorticated Cotton Cake ...	...	...	...	...	...	...
Undecorticated Cotton Cake—						
Bombay (Home-manufactured)	11 0 0	10 2 6	10 5 0	9 10 0	10 15 0	10 7 0
Egyptian (Home-manufactured)	12 0 0	...	10 12 6	...	11 0 0	...
Palmnut Kernel Cake ...	9 15 0	9 0 0	9 10 0	...	...	...
Groundnut Cake ...	13 6 0	...	14 6 3	...	15 0 0	...
Germ Cake ...	14 10 0	...	14 17 6	...	14 10 0	...
Germ Cake (Paisley) ...	...	...	13 7 6	...	14 0 0	...
Bean Meal ...	12 11 6	13 4 0	13 10 0	13 0 0	15 4 0	16 10 0
Locust Bean Meal ...	13 15 0	12 10 0	12 17 6	10 5 0	12 1 8	10 10 0
Paisley Meal ...	10 10 0	...	10 0 0	...	...	...
Maize ...	10 17 0	11 14 0	11 6 3	11 10 0	10 15 0	11 10 0
Maize Meal ...	12 7 0	13 4 0	12 8 9	13 0 0	12 5 0	12 12 0
Maize Germ Meal ...	11 15 0	...	...	...	...	...
Maize Gluten Feed ...	...	...	10 10 0	...	10 6 0	...
Rice Meal ...	7 10 0	...	9 15 0	...	9 15 0	...
Oats ...	11 1 0	12 0 0	11 16 3	12 0 0	12 18 0	12 0 0
Barley (Feeding) ...	11 4 0	10 8 0	11 15 0	10 0 0	12 1 8	10 0 0
Malt Culms ...	5 0 0	4 0 0	5 10 0	4 15 0	6 12 0	6 0 0
Distillery Mixed Grains—						
Dried ...	7 3 9	6 11 0	8 12 6	7 12 6	9 10 0	8 4 0
Wet ...	...	...	...	1 10 0	...	1 12 1
Brewers' Grains						
Dried ...	6 11 0	6 1 0	7 10 0	7 2 6	8 12 6	7 14 0
Wet ...	...	...	...	1 10 0	...	1 12 1
Wheat Middlings (Fine Thirds or Parings)	9 8 0	9 0 0	12 2 6	11 15 0	13 18 0	13 4 0
Sharps (Common Thirds) ...	7 4 0	...	9 12 6	...	11 0 0	...
Bran (Medium) ...	6 17 0	6 12 0	8 3 9	7 17 6	9 18 0	9 18 0
Bran (Broad) ...	...	...	...	...	...	...
Feeding Treacle ...	10 10 0	12 0 0	...	12 0 0	...	10 4 0
Fish Meal ...	17 9 0	18 2 0	16 2 6	16 10 0	16 0 0	16 0 0

Printed under the authority of HIS MAJESTY'S STATIONERY OFFICE
By DANIEL MACFARLANE & CO., LTD., 8 CHAMBERS STREET, EDINBURGH.

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